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### “A Silent Threat: Plastic Pollution in the Littoral Zones of Uttara Kannada, Karnataka”

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#### Abstract

Karwar Coast is the headquarters of the Uttara Kannada District and is described as Karnataka's Kashmir by the Nobel laureate Rabindranath Tagore for its scenic beauty which makes perfect tourist destination. Every year thousand tonnes of garbage composed of plastics, glass, metals, sanitary, clothes etc reach the oceans and the plastics contribute more than 60% of the total garbage that finds its pathway to the ocean in this region. The Coastal cleanup activities were carried out in two different beaches i.e. Aligadda beach and Rabindranath Tagore beach during years 2018, 2019, 2021, 2022 and 2023 by staff and students of Department of studies in Marine Biology. An area of 1 km beach was chosen for collection of litter in all the listed beached during respective years. During the year 2018 (Aligadda Beach) total of 4000 Kg litter was collected and observed in the following order Plastic items > Fishing materials > Food Wrappers = Clothes & Shoes > Burnt Crackers. Whereas in the year 2019 (Rabindranath Tagore Beach) total of 451Kg litter was collected and observed in the following order Plastic items = Food Wrappers > Miscellaneous waste > Beverage Glass bottles > Clothes & Shoes > Fishing Materials. Total of 1043 Kg of litter was collected in the year 2021(Rabindranath Tagore Beach) which was observed in following order Miscellaneous waste > Plastic items > Clothes & Shoes > Beverage Glass Bottles > Fishing Materials > Beverage Plastic Bottles. Where as during year 2022 (Rabindranath Tagore Beach) total of 451Kg litter was collected and observed in the following order, Plastic items > Beverage Glass bottles > Clothes & Shoes > Food Wrappers > Beverage Plastic Bottles. During the year 2023(Rabindranath Tagore & Aligadda Beach) total of 597.35Kg and 497.3 Kg was collected respectively, of which Plastic items and Food wrappers dominated in Rabindranath Tagore Beach, whereas Plastic and Fishing Materials dominated in Aligadda Beach. From the above observation it can be stated that the debris is more of tourism based wastes in Tagore beach and fishing items in the Aligadda beach.

**Keywords:** *Littoral litter, Plastics, Marine Biology, Tagore beach, Aligadda beach, Karwar*

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## **. Introduction**

Million tonnes of plastic debris enter marine environment each year posing a significant threat to the health and biodiversity of these vital ecosystems. Majority of the plastic pollutants originates on land finding its way to the oceans through rivers, creeks and canals. The intertidal zone, is a dynamic ecosystem supporting a rich diversity of plant and animal life [1]. However, this unique environment is increasingly threatened by the accumulation of waste, particularly non-biodegradable materials. The impact of waste on intertidal organisms is profound, with far-reaching consequences for ecosystem health and biodiversity.

Non-biodegradable waste, including plastics, metals, and other synthetic materials, poses a significant risk to intertidal organisms. Marine organisms in these zones can become entangled in debris, leading to injuries, suffocation, or impaired mobility. Ingestion of plastic particles mistaken for food can cause internal blockages, malnutrition, and toxicity, affecting the survival and reproductive success of various species [6]. Moreover, the presence of waste alters natural habitat structures, disrupts ecological processes, and introduces harmful chemicals into the environment, further exacerbating the challenges faced by intertidal organisms [2].

The importance of cleaning the intertidal zone cannot be overstated in mitigating these adverse impacts. By removing waste from these sensitive habitats, we not only protect intertidal organisms from harm but also preserve the overall health and functioning of these ecosystems. Cleaning efforts help maintain the integrity of habitat structures, prevent wildlife entanglement and ingestion, and reduce the spread of pollutants that can have long-lasting effects on marine life[3].

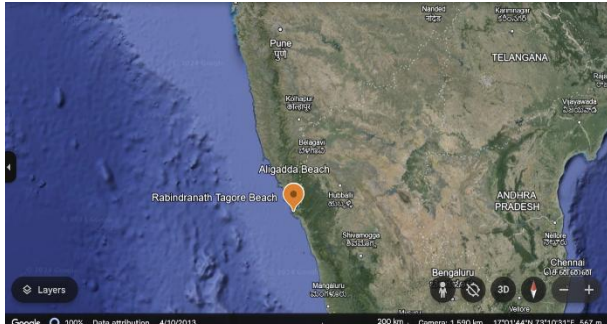
Furthermore, a cleaner intertidal zone benefits not only the organisms that inhabit these environments but also the broader coastal ecosystem and human communities. Healthy intertidal zones support essential ecological processes, such as nutrient cycling, shoreline stabilization, and biodiversity conservation [4,5]. By cleaning up waste in these areas, we contribute to the sustainability of coastal fisheries, promote ecotourism, and enhance recreational opportunities for locals and visitors alike.

Engaging in intertidal zone cleaning initiatives is a proactive step towards preserving the intrinsic value of these ecosystems and protecting the services they provide to society. Community involvement in beach clean-up activities, waste management education programs, and policy advocacy for stricter regulations on waste disposal are essential components of effective conservation efforts.

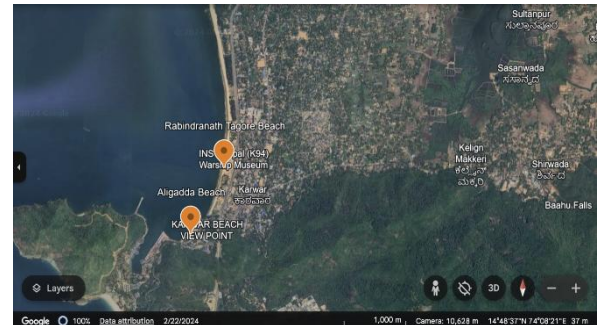
## **Materials and Methods**

Every year on the occasion of International Coastal Clean Day, Beach cleaning activity was carried out from year 2018 to 2023 in two beaches namely Rabindranath Tagore Beach (14.8108326 N & 74.1257439 E) and Aligadda (14.8018491 N & 74.1207774 E) of Uttara Kannada Karwar. The beach cleaning was done in one kilometre stretch with the voluntary participation of 75 members from Department of studies in Marine Biology Karwar, students and staff from different schools and institutions. The team was equipped with all the necessary cleaning tools like gloves, rakes and gunny bags for the collection and segregation of collected debris. The litter from beach were collected and segregated item wise like plastic

items, food wrappers, clothes & shoes, beverage plastic bottles, beverage glass bottles, fishing materials, medical waste and miscellaneous waste. These segregated litter was weighed separately item wise and handed over to the municipality for recycling and further processing.



**Figure 1- Map Showing Karwar Town**



**Figure 2- Map showing Tagore Beach & Aligadda Beach**



**Figure 3- Beach Before cleaning**



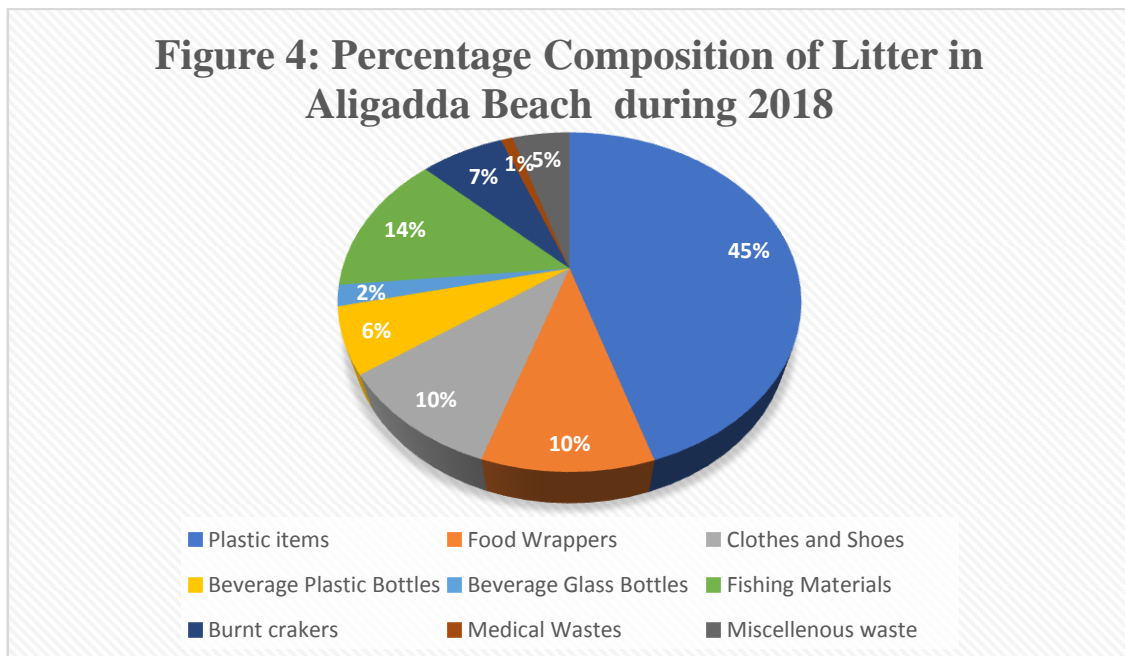


## Results

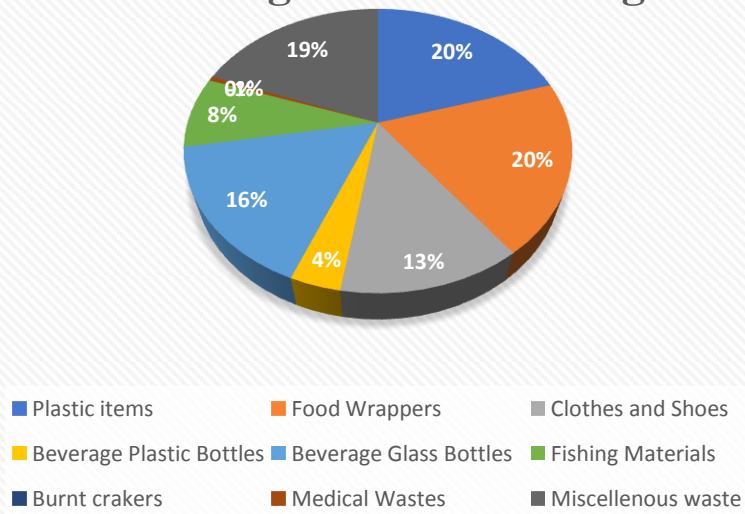
The comparative percentage of intertidal beach litter in the Aligadda Beach during year 2018 and 2023 was carried out (Fig.10). In the year 2018 the beach litter collected was 4000 Kg (Fig.4), whereas it was 497.3 Kg in year 2023 (Fig.9). The highest percentage of plastic items (45%), followed by fishing materials (7%), food wrappers (10%), clothes & shoes (10%), burnt crackers (7%) and beverage plastic bottles (6%) was observed in year 2018 whereas in 2023 it was plastic items (36%), followed by fishing materials (22%), clothes & shoes (12%), beverage plastic bottles (10%), beverage glass bottles (7%), food wrappers (7%) and miscellaneous waste (6%).

The comparative percentage of beach litter in the Rabindranath Tagore Beach during year 2019, 2021, 2022 and 2023 was carried out (Fig.11). In the year 2019 the collected beach litter was 451Kg (Fig.5) whereas in 2021 it was 1043Kg (Fig.6) followed by 566kg (Fig.7) in 2022, and in 2023 it was 597.35Kg (Fig.8). The plastic items showed increasing trend from 20% to 38% during these years. In the year 2019 the plastic items and food wrappers were 20% each, miscellaneous wastes(19%), beverage glass bottles(16%), clothes & shoes (13%) and fishing materials(8%). Whereas in year 2021, highest percentage of miscellaneous wastes (29%) followed by plastic items (23%), clothes & shoes (18%), beverage glass bottles (12%), fishing materials (8%), beverage plastic bottles (5%) and food wrappers (4%). In the year 2022 plastic items (27%) followed by beverage glass bottles(26%), clothes & shoes (21%), food wrappers (12%), miscellaneous wastes(12%) and beverage plastic bottles (6%). In the year 2023 plastic items (38%) followed by food wrappers (24%), clothes & shoes (12%), beverage glass bottles (8%), beverage plastic bottles (7%) and fishing materials (7%).

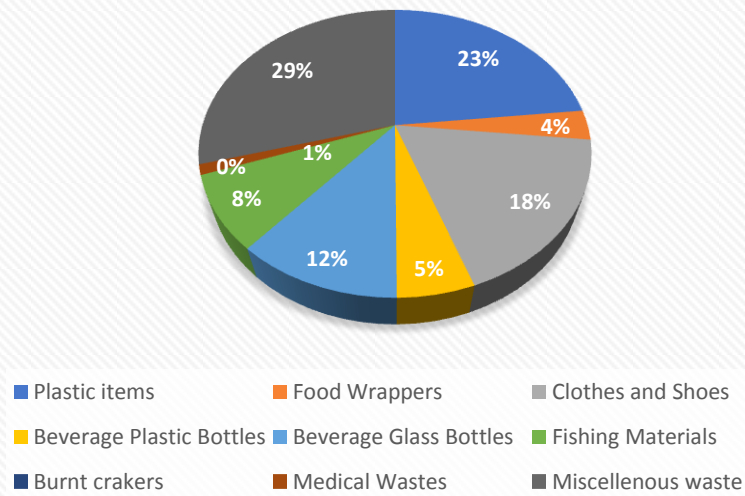
Based on the present study it can be stated that strong positive correlation exists between 2018 and 2023 of litter in Aligadda beach. In Rabindranath Tagore beach from the year 2019 to 2023 moderate correlation was exhibited with reference to beach litter.



**Figure 5: Percentage Composition of Litter in Tagore Beach during 2019**

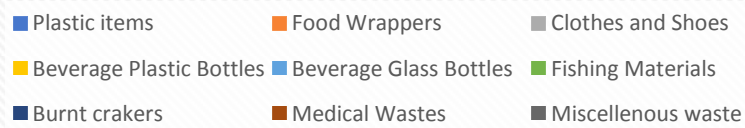
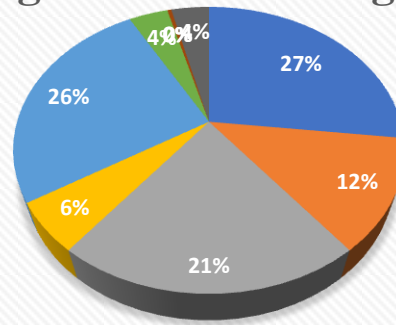


**Figure 6: Percentage Composition of Litter in Tagore Beach during 2021**

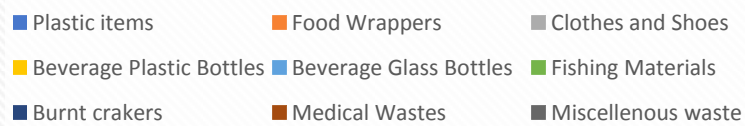
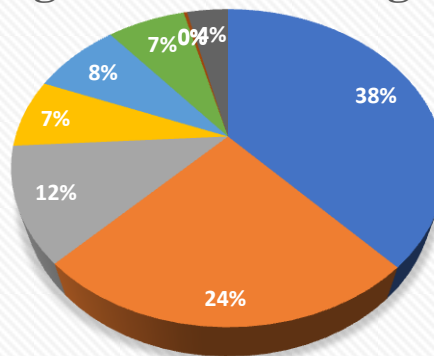




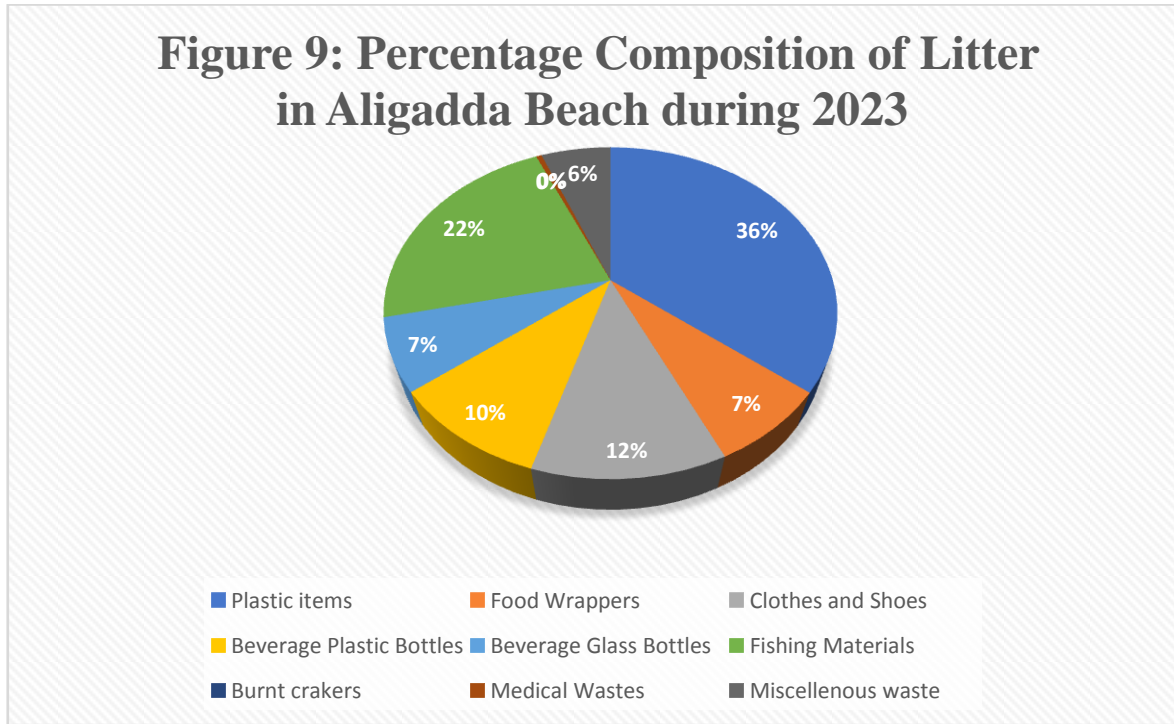
**Figure 7: Percentage Composition of Litter in Tagore Beach during 2022**



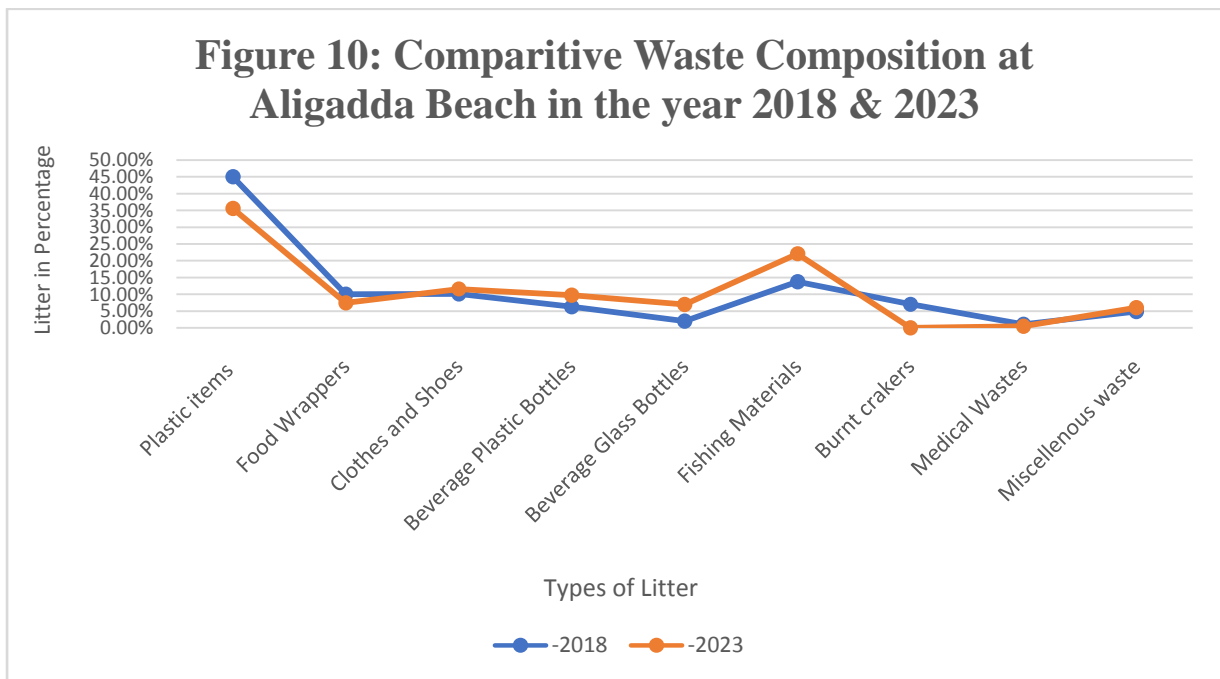
**Figure 8: Percentage Composition of Litter in Tagore Beach during 2023**



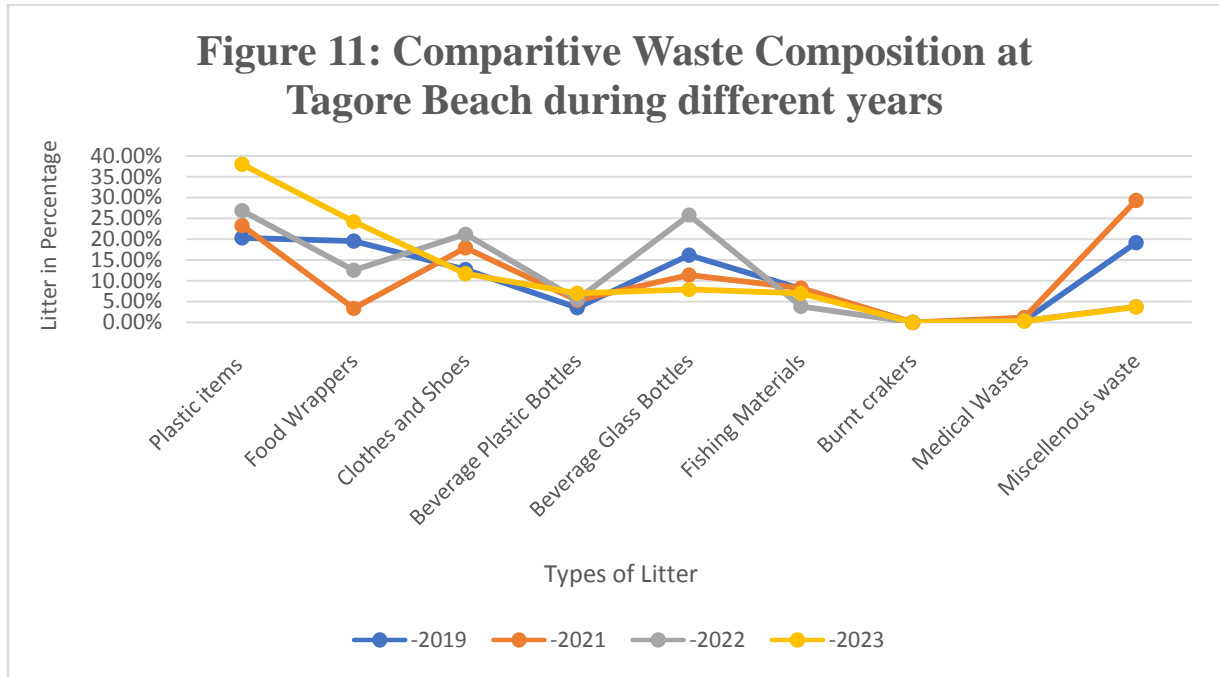
**Figure 9: Percentage Composition of Litter in Aligadda Beach during 2023**



**Figure 10: Comparitive Waste Composition at Aligadda Beach in the year 2018 & 2023**







**Figure 12: Beach After Cleaning**



Beverage C

Plastic items



Food Wrappers



Plasti



Clothes



Segregated Beach Litter



## Conclusion

The waste which was collected on the studied beaches indicates more of tourism based waste on the Rabindranath Tagore beach whereas in Aligadda more of fishing related wastes are more due to lot of shore seine fishing activity seen in this beach. Based on present study it was found that Plastic items dominated the wastes in almost all the beaches followed by bottles, food wrappers, and footwear most of them likely originate from tourist activities. Another significant contributor is online food/other parcel services, increased use of disposable packaging materials. Proper waste management practices should be incorporated like placing of waste collection bins, item wise segregation and recycling should be taken care by local bodies like municipality/gram panchayat, etc. Awareness among stake holder about the negative effect on ecosystem and human health. Responsible management of wastes should be practiced by fishermen and tourist. Eco-friendly tourism activities need to be strictly followed and monitored. Intertidal zone provides habitat for millions of organisms, any kind of pollution, hinders normal functioning of these organisms, and result in forcing the organisms to migrate to the suitable environment. Many turtles visit these beaches every year for spawning these organisms avoid visiting polluted beaches, this may result in decrease in the turtle population. The intertidal zone is a vital ecosystem that requires our attention and care to thrive. By recognizing the detrimental effects of waste on intertidal organisms and understanding the importance of cleaning these habitats, one has to work towards a sustainable future where coastal environments are clean, healthy, and resilient. Through collaborative efforts and a commitment to responsible waste management practices, we can protect intertidal ecosystems for generations to come.

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