Evaluation of Marine Litter Pollution Level in a Urban Beach (Aegean Coast of Izmir, Turkey)

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Abstract. The Ağapark beach is one of the affected beach from marine litter (ML) pollution due to industrial and domestic activities. In this study, the degree of ML pollution was investigated in the beach using Clean Coast Index (CCI). The beach typology was determined according to the Bathing Area Registration and Evaluation (BARE) system. Beach litter types and characteristics were determined on the basis of the “Guide on Monitoring Marine Litter in European Seas”. In this study, a total of 1,770 items of ML were collected from Ağapark beach. Plastic was the most abundant material in the beach. Mixed packaging litter was most dominant litter source in the beach. As a result of BARE, Ağapark beach was determined as “urban” beach status. As a result of CCI, Ağapark beach was “moderate” in winter and spring, while the beach was “dirty” in summer.

1 Introduction

ML which is formed as a result of the manufacturer or the consumer, randomly throwing the products without recycling or disposal; it accumulates in the coastal and marine environment by being transported by wind and current paths. ML is any persistent, solid material that has been produced, processed and dumped, disposed of or left in the coastal or marine environment (Aytan et al., 2019).

ML accumulates on the coasts and in the seas and is consumed by various marine organisms. These litters that are consumed cause injuries, blockages, reproductive and feeding problems and deaths in the digestive system. ML constitute a substrate for living life, carries pathogen/invasive species to regions where they do not belong by currents and winds and affects biodiversity. ML, which causes aesthetic negativities in coastal areas, causes serious economic problems by affecting tourism and fishing equipment (Gündoğdu et al., 2019; Güngören and Başaran, 2021).

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Ağapark beach is subjected to a considerable amount of ML accumulation through the prevailing anthropogenic use. Thus, this study aimed to evaluate the abundance, composition and sources of ML in the Ağapark beach coast, seasonally.

2 Materials and Method

Alağa, the industrial center of Izmir city, is located on the coast of the Aegean Sea (Figure 1). The population of around 106,168 people/km² and, this number increases considerably in the summer season.

Fig. 1. Location of Aliağa Ağapark beach

ML items were seasonally collected at Ağapark beach (38.838446 N – 26.966788 E) in the present study. Visual beach litter quality grade is determined according to the UK Environmental Authority's National Marine Litter Group litter assessment protocol (EA/NALG, 2000). There are a total of four categories in this method, with a beach rating describing the aesthetic quality as “A” grade (Very Good), “B” (Good), “C” (Medium) and “D” (Poor).

According to the BARE system (Williams and Micallef, 2009), each coastal area is divided into four classes according to its transportation difficulty, population and use in community services: Remote Areas, Rural Areas, Village Areas, Urban areas.
The samplings were performed by following standardized protocols of Marine Litter Monitoring Guidance. The collected ML was separated into categories according to the method adopted by the United Nations Environment Program (UNEP) in collaboration with the Intergovernmental Oceanographic Commission to quantify solid waste in beach areas (EU MSFD Technical Group on Marine Litter, 2013). ML abundance was calculated by its density in items/m². The degree of beach cleanliness was evaluated according to CCI, with classes varying between very clean (CCI = 0-2 items/m²), clean (CCI = 2-5 items/m²), moderate (CCI = 5-10 items/m²), dirty (CCI = 10-20 items/m²) and extremely dirty (CCI > 20 items/m²) (Alkalay et al., 2007).

3 Results and Discussion

In this study, a total of 1,770 items of ML were collected from Ağapark beach. Plastic was the most abundant material in the beach (Figure 2). Paper/cardboard was the second abundant material among ML on Ağapark beach. As a result of researches on ML in coastal areas of Turkey, it has been observed that the type of litter with the highest percentage is plastic (Aytan et al., 2019; Ertaş et al., 2022). Paper/cardboards are transported either directly by water fluxes or wind influences (Ertaş et al., 2022).

Fig. 2. Composition of ML in Ağapark beach.

Mixed packaging litter was the most dominant litter source in Ağapark beach. Mixed packaging litter are frequent in daily use and drifted by people coming to the beach for recreational activities such as picnic and sunbathing or by throwing these materials from ships (Ertaş et al., 2022). Domestic litter was secondly dominant litter source in Ağapark beach (Figure 3). In the study conducted in Kuşadası, Güllük, Gökova and Marmaris Bays, the reason for the pollution was shown as both the stations being very famous touristic places and the excessive use of this region in ship trade, daily tours, fish farming and fishing activities (Cerim et al., 2014). The ghost nets lost or thrown under water constitute the main source of fisheries related litters over time (Ertaş et al., 2022).
The mean ML density and CCI values obtained from the present study (Spring 0.391±7.82 items/m², Summer 0.768±15.3; Autumn 0.742±14.8; Winter 0.31±6.2) are showed in Table 1. These results are extremely worrying considering other studies in Mediterranean and Aegean coast (Gündoğdu et al. 2019; Ertaş et al., 2022). In this study, the values obtained from Ağapark beach are higher than the values obtained from Cerim et al. (2014) and Gönülal et al. (2016) on the Aegean coasts. As a result of the increase in tourism activities on all Aegean coasts in hot and mild months, the accumulation of ML on the beaches has created pollution pressure (Ertaş et al., 2022).

Table 1. Beach typologies, seasonal ML amounts and CCI classification of Ağapark beach.

<table>
<thead>
<tr>
<th>Sampling sites</th>
<th>Beach Typology</th>
<th>Visual Aesthetic Quality</th>
<th>Total ML Amount (item)</th>
<th>ML Amount (item/m²)</th>
<th>Sampling Width - Length (m)</th>
<th>Numeric index</th>
<th>Quality class</th>
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<tbody>
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Fig. 3. Source of ML in Ağapark beach.
Plastic material, which has a very long deterioration time due to its high durability and strength (Aytan et al., 2019), continues its existence in nature for a long time. This, in fact, causes the continuous accumulation of plastics, which are thought to disappear with each passing year. In addition, plastic litter undergoes physical decomposition in nature, forming microplastics, making it more difficult to see and collect (Gündoğdu et al., 2019; Güngören and Başaran, 2021). The fact that people go to the seaside before the start of the normal 3-month summer season and even continue the sea and holiday season until mid-October has caused more anthropogenic pollution in the marine environment (Güngören and Başaran, 2021).

4 Conclusion

In order to reduce ML pollution, it is necessary to prevent the formation of pollution before taking various measures at the regional and international level. If the sources causing the pollution are known, elimination procedures should be applied at the source. As a suggestion, plastic manufacturers may be required to recycle up to 60% of the plastic they produce. Municipalities are required to constitute a management plan for ML and contribute to its collection. When looking at the steps that can be taken in the industrial sense, investments should be made in the technologies necessary for the production of renewable and sustainable raw materials. In this way, both recycling is supported, and the repetitive consumption of existing resources is prevented. This may indirectly be a measure to prevent the increase in the number of existing plastics. Not only mechanical recycling, but also chemical recycling should be used. In chemical recycling, materials that are not suitable for recycling can also be recycled, so it is a method that can be effective in reducing the amount of ML.

References

4. EA/NALG, Assessment of Aesthetic Quality of Coastal and Bathing Beaches. Monitoring Protocol and Classification Scheme” (Environment Agency and The National Aquatic Litter Group, 2000)
7. O. Gönülal, İ. Öz, S.Ö. Güreşen, B. Öztürk, Abundance and composition of marine litter around Gökçeada Island (Northern Aegean Sea)” Aquatic Ecosystem Health & Management, 19(4), 461-467 (2016)