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Distribution and composition of benthic marine litter on the shelf of Antalya in the eastern Mediterranean

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ABSTRACT

In recent years, the pollution of the seas by the litter has identified as a serious environmental problem. Studies indicate that the majority of the marine litter consists of plastic, which is a result of human actions that also affected by river input, fishing activity and current systems. Thus, this study mainly focused on the distribution and composition of benthic marine litter. The sampling was carried out in Antalya Bay with a demersal trawl. A total of 68 hauls were performed and 370 pieces of 136.3 kg litter were collected. The density values vary between 13.3 and 651.1 n/km^{-2} and weight values vary between 0.02 and 559 kg/km^{-2} in overall litter. Distribution, density - weight indices by testing the differences with the depth, season and transect were analysed. Depth had a significant impact on both density and weight indices. Marine litter monitoring program is necessary for offering more solution proposals.

1. Introduction

Intentionally or not, marine litter (debris) is a result of human activity and behaviour. It is also the outcome of poor waste disposal and absence of public awareness of the potential outcomes of unsuitable waste management (Andrady, 2011). According to the Cheshire and Adler (2009), marine litter is “any persistent, manufactured or processed solid material discarded, disposed or abandoned in the marine and coastal environment”. It is a worldwide problem and an absolute threat to the marine environment. In the marine habitat, litter can be transported from land, via rivers, stormwater, wind and sewage, or can be disposed of directly at beaches and at sea (UNEP/MAP, 2011). There are many types of marine litters such as plastics, metals, glass and textiles as seen on the beaches, floating on the surface of the sea or sank to the seafloor. Beyond the aesthetic pollution, marine litter has significant environmental, economic and social impacts and poses serious risks to aquatic organisms and human health (Papadopoulou et al., 2016).

Many studies indicate that marine debris is mainly composed of plastic items with a growing global annual production of 299 million tons (Bergmann et al., 2015). According to Engler (2012), about 50% of plastic marine litters especially low-density polymers (polyethene - PE and polypropylene - PP) sink to the seafloor. As the litter reaches to the bottom, it tend to become trapped in rocky bottoms or low circulation areas and may already have been transported a considerable distance on sinking when weighed down by entanglement and fouling (Barnes et al., 2009; Ioakeimidis et al., 2015).

The Mediterranean Sea is a semi-closed basin and shows great densities of the marine litter because of marine traffic, populated coastline, complex currents, riverine inputs and tidal flow with having a limited water exchange through the Suez Canal and the Strait of Gibraltar (Bergmann et al., 2015). Considering the existing data, Mediterranean may be the most affected sea in Europe as well as over the world, with densities higher than 100,000 n/km^{-2} on the seabed close to metropolitan areas (Galgani et al., 2013). In the world, the Mediterranean Sea has a concentration of 9% floating marine litter which is the fourth highest of the total (Eriksen et al., 2014; Suaria et al., 2016). Studies on marine litter in the Levantine Sea (eastern Mediterranean) of Turkey carried out in İskenderun Bay (Yılmaz et al., 2002), Antalya Bay between 200 and 600 m depths (Güven et al., 2013) and in Mersin Bay with using selectivity grids on demersal trawl (Eryaşar et al., 2014).

Antalya is one of the most important tourism zones of the eastern Mediterranean. It is a coastal region where about 22 million tourists expected to visit in 2018 (Report, 2017). The intensity of tourism and commercial ship traffic in the Antalya Bay and the intensive amount of domestic and foreign tourists' activities especially in summer also brings marine pollution.

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Considering all, the monitoring programs play a key role in determining a strategy with the monitoring data. It is also necessary for setting up various solutions for the success. This monitoring usually includes various ways such as beach - sea surveys and estimation of the amounts entering the sea. (UNEP/MAP, 2015) Furthermore, depending on the size of the marine litter, intensive sampling required to specify debris abundance at a spatial scale; observation from the deck, trawl sampling and aerial surveys are the most acceptable methods (Galgani et al., 2013).

The main objective of this study is to determine the distribution and composition of benthic macro litter deposited on the inner shelf (10–50 m), middle shelf (50–100 m) and outer shelf (100–200 m) with the middle bathymetric line of upper slope (300 m). To achieve this, marine debris items collected by trawl operations covering a year from the bathyal zone of Antalya Bay eastern Mediterranean. This study aims to produce valuable information on a benthic marine litter through bottom trawling by using standardized methodology and protocols (for more see; (MEDITS, 2017; UNEP/MAP, 2015) and database (EEA, 2018)). The information provided from this study will contribute to the density, weight, distribution and composition of marine litter in different categories including various parameters (depth, season, transect) for improving awareness, ecosystem health, management and pre-start of the monitoring of marine litter.

2. Materials and methods

The data on marine litter were collected on three (T1, T2 and T3) transects with a total of 68 stations. T1 and T2 transects were located in open fishing area while T3 was in the no-fishing zone. The study was carried out onboard the R/V "Akdeniz Su" at an average speed of 2.5 knots along the Gulf of Antalya (East Mediterranean Sea, Turkey), respectively in May, August, October 2014 and February 2015 over 10 days per month (Fig. 1). Litters were collected with bottom trawling with a conventional bottom trawl (600 meshes mouth opening polyethene codend with a mesh opening 44 mm, which equipped with 24 mm mesh opening polyamide cover).

There were five fixed trawling stations along each transect, located at depths of 10, 25, 75, 125, 200 m and one trawling station in-between transects at a depth of 300 m for improving the data. Haul duration was between 30 and 45 min. All sampling was conducted during daylight. After the haul, firstly trawl cover and secondly trawl codend was separately emptied on to the deck. Marine litter was sorted and split from the catch. Then, according to the basis of the MEDITS (2017) protocols, the materials were kept on the deck for a short time for the removal of seawater and washed with some fresh water to clean the sandy-muddy sediment from the bottom inside the marine debris. Litters were sorted into six different categories (plastic, rubber, metal, wood, glass and natural fibre) according to material types (Table 1). Following this process, all marine litter materials caught were classified by haul, counted and weighed separately to the nearest 0.5 g.

According to the wingspread of net (17.5 m), the swept area method (Sparre and Venema, 1998) was used for standardising the number of items (n) and weight (kg) for the estimation of the Density (number of individuals per area, n/km^{-2}) and weight (weight per area, kg/km^{-2})

Table 1
The composition of marine litter by categories enhanced from MEDITS surveys.

Category	Subcategory
Plastic	PVC (polyvinyl chloride)
	PP (polypropylene)
	PE (polyethylene)
	PA (polyamide nylon)
Rubber	Tyres
	Boots
	Rubber pieces
Metal	Cans
	Barrels
	Other metallic objects
Glass	Bottles
	Ceramics
Natural fibres	Textile
	Clothes
Wood	Processed wood
	Wooden boxes

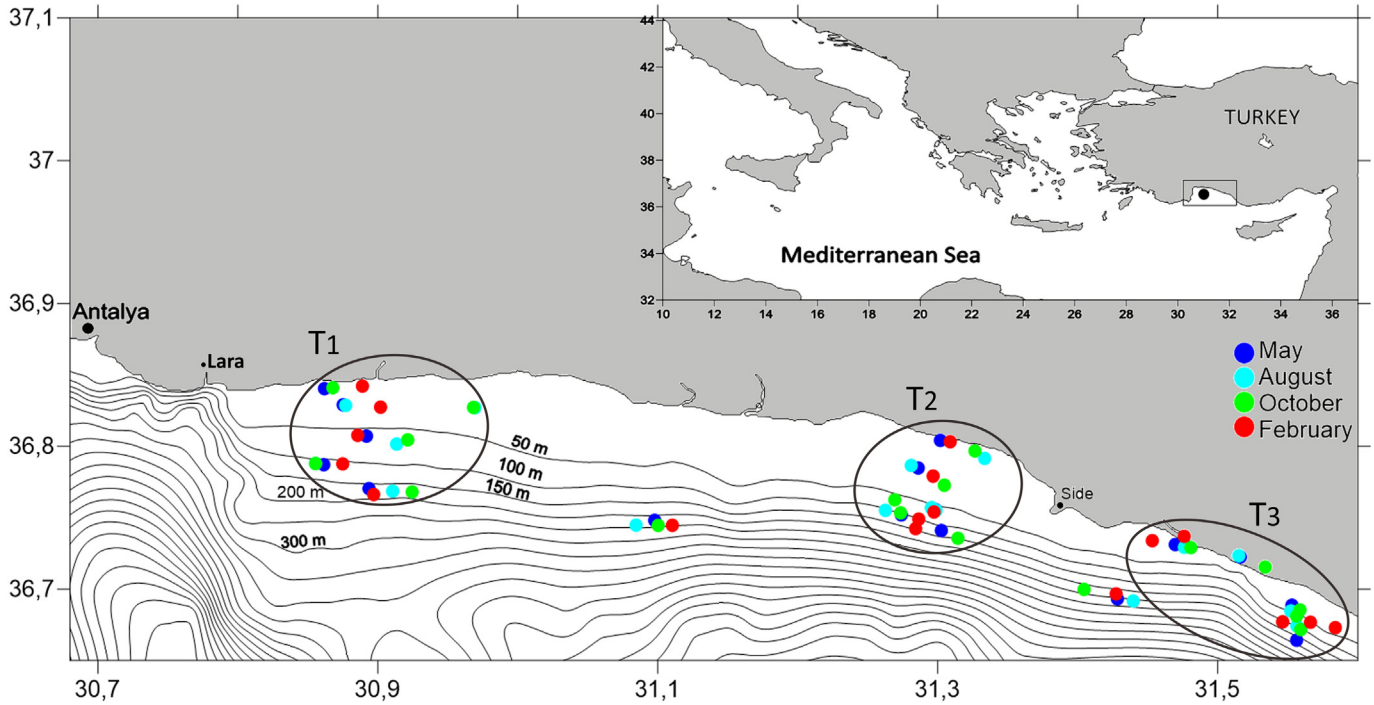

Fig. 1. Bathymetry map of the study area transects (T1, T2 and T3) and stations with seasons (May-Spring, August-Summer, October-Autumn and February-Winter) in Antalya Bay.