



International Journal of Environment and Geoinformatics (IJEGEO) is an international, multidisciplinary, peer reviewed, open access journal.

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**Abstracting and Indexing:** Index Copernicus, Open Academic Journals Index, Scientific Indexing Services

## Seafloor Litter in the Sinop İnceburun Coast in the Southern Black Sea

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Received 28 Feb 2017

Accepted 01 Nov 2017

### Abstract

In this study, abundance, distribution and type of seafloor litter were determined in the Sinop Inceburun coast which is the northeast point of Turkey. Study was carried out in October 2014 and proposed methods by Guidance on Monitoring of Marine Litter in European Seas' published by European Marine Strategy Framework Directive Technical Subgroup on Marine Litter section of seafloor litter adopted the region. Seafloor litter density was found mean  $808.74 \pm 215.02$  pieces per  $\text{km}^{-2}$ . The amount of litter was found maximum in 34 m depth. When results were evaluated in terms of the type of material plastic was found 95.35% and encountered litter items were mainly composed of plastic bags. The size groups were found generally small than 50 cm x 50 cm in the classification according to the size groups. The data obtained from the study demonstrate that the seafloor in the region have highly littered compared to the other studies in the Black Sea. Marine litter pollution is a growing problem in the world all of the world's oceans and also the Black Sea. Necessary measurements must be taken to solve this problem.

**Keywords:** Black Sea, İnceburun, Marine litter, Plastic

### Introduction

Marine litter has become an extended pollution problem impacting all of the world's oceans (Allsopp et al., 2006) and the Black Sea which is an almost totally enclosed sea and is vulnerable to pollution, have been described as one of the most affected areas. Marine litter may consist of 'plastics, wood, metals, glass, rubber, clothing, paper etc.' and is a globally recognized environmental issue of increasing concern. A report of UNEP 2009 summarizes, marine litter is "an environmental, economic, health and aesthetic problem". Marine litter in the marine environment can be transported from land, via rivers, storm-water, wind and sewage, or can be disposed of directly deliberately left by people on beaches and shores or accidentally lost, including material lost at sea in bad weather (UNEP, 2005;2011). In these days, plastics dominate marine litter that are one of the most widely used substances over the world. Plastic litter in the marine environment find all over the world, from equator to Polar Regions and the contamination

degree of marine environment with plastic litter is quite a lot (Allsopp et al., 2006).

Marine Strategy Framework Directive (2008/56/EC) (MSFD) published by European Union (EU) in 2008, includes necessary measures to provide or maintain "Good Environmental Status" (GES) of the Member States up to 2020. In Annex I to Directive 2008/56/EC is determined GES according to 11 qualitative 'descriptors' for marine regions and sub-regions and Descriptor 10 is related to marine litter. Descriptor 10 describe marine litter as "Properties and quantities of marine litter do not cause harm to the coastal and marine environment" (2010/477/EU). The implementation of MSFD the Member States of the Black Sea and an associated member of Turkey improve their national monitoring systems and to contribute to the development of a target oriented integrated monitoring system for the Black Sea.

The Black Sea is an enclosed sea encompassing the largest anoxic basin on the world, because of the limited water renewal and unique

connection with the Mediterranean Sea is the narrow passage of the Turkish Straits System (Oğuz et al., 2004) and it has always been a basin with a positive water balance (Yüce and Gazioglu, 2006; Balkıs et al., 2012). This matchless feature renders the Black Sea ecosystem rather vulnerable to anthropogenic pressure (Algan, et al., 1999; 2002; Öztürk et al., 2013). Many rivers discharge into the Black Sea and it is also a significant shipping route and is exposed to intense fishing activities. Consequently, it is sensitive to any kind of pollution, including solid wastes (Algan et al., 2000; Güven et al., 2010; Topçu and Öztürk 2010). Scientific studies on marine litter have gained speed in recent years but it is still quite inadequate in the Black Sea and there are very few peer reviewed scientific publications on this topic (BSC, 2009; UNEP, 2009; Vişne and Bat 2015). There are relatively more scientific literatures about the seafloor litter in the Black Sea (Topçu and Öztürk 2010; Terzi and Seyhan 2013a; Anton et al., 2013; Ioakeimidis et al., 2014) compared to beach litter studies (Topçu et al., 2013; Terzi and Seyhan 2013b; Vişne and Bat 2016a,b). All these studies mentioned that there is a large quantity marine litter in the Black Sea coasts and the most common marine litter type is plastic and Topçu and Öztürk (2010) reported that marine litter concentrations in the Black Sea seafloor were higher than in the Mediterranean Sea.

İnceburun which is the northeast point of Sinop, located in the Central Black Sea Region. Sinop is a residential area where industrial pollution is absent, fishing and tourism are prominent. There is a domestic pollution which is caused by increasing population, observed only in summer months. There is no pollution that can be considered important in the Sinop coasts (Bat and Gökkurt-Baki, 2014), but Sinop is highly influenced from regional winds and currents and wastes which are carried from different regions are stored in the shores. It has been reported that massive amounts of marine litter are stored especially in the beaches in Sinop coasts (Vişne and Bat 2016a,b). The aim of this study is to determine the abundance, spatial distribution and composition of seafloor litter in the İnceburun and in our study used monitoring protocol proposed by the Technical Group on Marine Litter (MSFD GES Technical Subgroup on Marine Litter 2013).

### Materials and Methods

Sinop belongs geographically to the west Black Sea Region of Turkey. The coastline of the area is about 175 km long and lies between E 34° 13'29" and E 35° 28'17" longitudes. Study was carried out in the İnceburun (N 42° 06') which is the northeast point of the Sinop (Fig. 1).

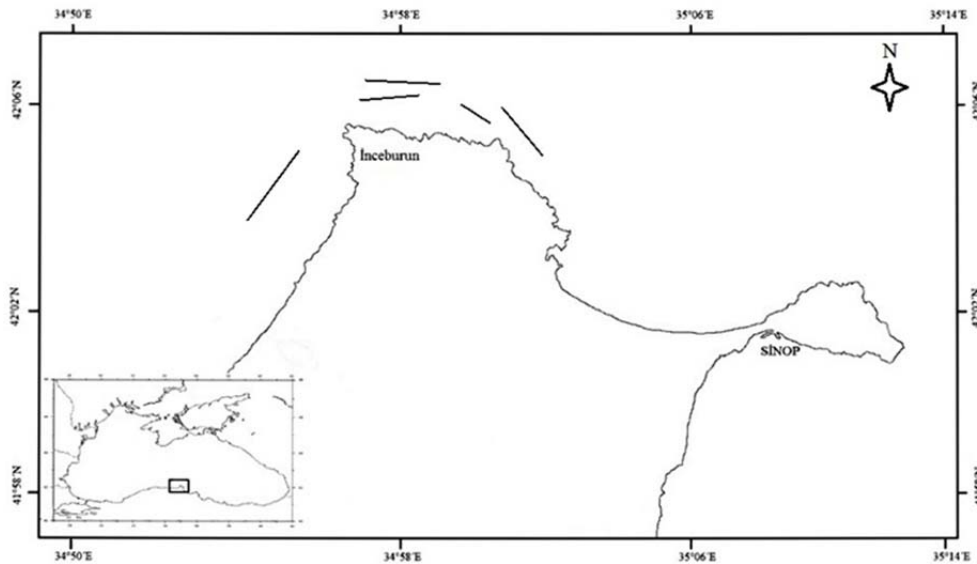


Fig 1. Study area

Study was carried out in October 2014 and during surveys was used bottom trawl net which is 10 m mouth opening and 22 mm mesh size at speeds of 2 knot. Five trawl shots taken between 20-40 m depth and lasted between 30-45 minutes. The swept area (a) was estimated from Sparre and Venema, (1992) [ $a = D \cdot hr \cdot X2$  (hr= is the length of the head-rope-wing spread,  $X2 = 0.5$  the bottom trawl value, D= distance towed)] and the amount of litter per  $km^2$  was calculated.

Proposed methods by Guidance on Monitoring of Marine Litter in European Seas' published by European Marine Strategy Framework Directive Technical Subgroup on Marine Litter section of seafloor litter adopted the region (MSFD GES Technical Subgroup on Marine Litter 2013). Encountered litter items were categorized according to the material type (plastic, wood, cloth and textile), possible usage (mixing packaging items, personal usage items, fishing related items, unidentified etc.) and size groups [ $<5 \times 5$  cm (A),  $<10 \times 10$  cm (B),  $<20 \times 20$  cm (C),  $<50 \times 50$  cm (D),  $<100 \times 100$  cm (E) and  $>100 \times 100$  cm (F)].

**Results**

Total swept area was calculated as  $0.0549 km^2$ . Seafloor litter density was found between  $109.39-1384.34$  pieces  $km^{-2}$  and mean

$808.74 \pm 215.02$  pieces  $km^{-2}$ . Most polluted depth was found 34 m and the least polluted depth was found 20 m which was the closest station to shore (Table 1).

When results were evaluated in terms of the type of material, the most common litter type was found plastic (95.35%) and it's followed by cloth and textile (2.33%) and wood (2.33%) (Fig. 2). Assessing the results according to their possible use areas indicated that marine litter in research area is heavily sourced from mixed packaging items. At the same time encountered with fisheries related items, domestic and household related items, construction related items and personal use and unidentified items. The most common size groups were found as D (41.30%) and followed by C (30.43%), E (17.39%), B (6.52%), and A and F (4.34%) (Fig.2).

**Discussion and Conclusion**

It is estimated that eventually 70% of marine litter ends up on the seabed in the North Sea (Hammer et al., 2012). The results obtained from the study indicate that the area is contaminated with the sea floor litter in dense amounts as in other studies in the Black Sea (Topçu and Öztürk 2010; Terzi and Seyhan 2013; Anton et al., 2013; Ioakeimidis et al., 2014) (Table 2).

Table 1. Coordinates of sampling polygons and litter density

Station	Depth	Coordinates		Litter Density (pieces/ $km^2$ )
		Start	End	
1	39 m	42°03.814 N	42°05.289 N	655,74
		34°53.908 E	34°55.392 E	
2	20 m	42°06.345 N	42°06.446 N	109,29
		34°57.072 E	34°58.773 E	
3	29 m	42°06.256 N	42°05.853 N	1092,90
		34°59.951 E	34°00.798 E	
4	34 m	42°06.227 N	42°05.168 N	1384,34
		34°01.105 E	34°02.274 E	
5	35 m	42°06.686 N	42°06.757 N	801,46
		34°59.399 E	34°57.246 E	

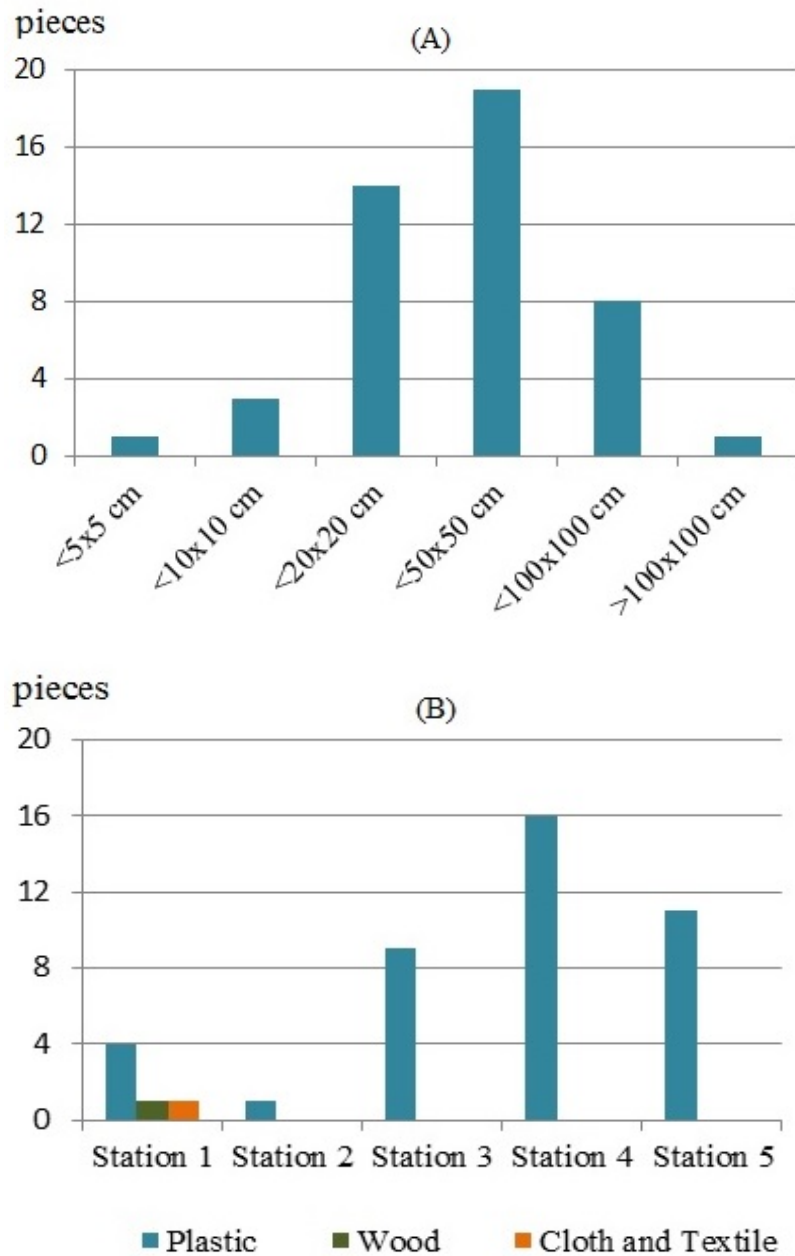


Fig 2. Proportional distribution of size groups (A) and material type (B)

Distribution of the litter on the seafloor are related to a number of factors such as prevailing wind, currents, eddy circulation patterns and convergence zone of seafloor sediment movements (Barnes et al., 2009; Moncheva et al., 2016). The Black Sea is characterized by a predominantly cyclonic and strongly time-dependent basin wide circulation that follows

approximately the continental slope around the basin (Korotaev et al., 2003). In region Sinop eddy may form repeatedly once or twice a year for about a season and sampling area is under the influence of regional winds, wave and currents. When considering the special condition of the region, it is possible that the litter density is found to be higher than most of the studies in the Black Sea.

Plastic litter constitutes 60% - 80% of all marine litter (Gregory and Ryan 1997). In all studies in the Black Sea region, the most common litter type was found as plastic like our study (95.35%). The endurance and surge usage of plastics make a big waste management problem (Thompson et al, 2009a). Taking into consideration the degradation time of the plastic materials, it is an indisputable fact that their existence in the ecosystem will last for many years and they will be found to be as pollutant for many years in the region. Substantial quantities of plastic have accumulated in natural environment and in landfills (Thompson et al., 2009b).

Most common used materials are plastic films, such as carrier bags, which are easily carried by the wind, as well as discarded fishing equipment and food and beverage packaging (Barnes et al., 2009). Plastic carrier bags were the most abundant plastic litter type in all study area. More than 8 billion plastic bags which is one of the most critical threats for the marine environment went to waste in the EU in 2010 (Ioakeimidis et al., 2014). The findings of the marine litter surveys in Black Sea shows the excessive use of plastic bags

Seafloor litter in the Inceburun region is mainly composed of plastic and plastics are subjected to degradation that is caused by a combination of various factors (thermal oxidation, biodegradation and hydrolysis etc.) after enter the environment (Hammer et al., 2012) and being less than 5 mm, they defined as microplastic. In recent studies, the presence of microplastics was reported all over the world oceans and microplastics were found various marine species digestive tract (Tanaka and Takada, 2016). Resulting from ingestion, concerns have also been raised about plastic litter transferring toxic pollutants into marine food chains (Thompson et al. 2009; Barnes et al., 2009; Ioakeimidis et al., 2014).

In the study, it has been observed that in large part of the sea floor litter originated from land-based sources (Fig. 3). Ioakeimidis et al. (2014) found this ratio 28.1% in Constanta Bay. This situation was explained with metal beverage cans and glass bottles showed vessel-based

sources as these types of litter cannot transport long distances and found near to coastal area (Ioakeimidis et al., 2014). Moreover garbage bags, shopping bags, plastic sheets and containers arise mostly from land-based sources such as domestic, agricultural and industrial activities. While the percentage of the land originated and the vessel originated litter was almost the same in Constanta Bay (Ioakeimidis et al., 2014), the land based sources was found maximum level in Inceburun of the southern Black Sea. There is no intensive ship traffic in the Inceburun but the region is heavily used by local fishermen. So that fisheries related items were encountered in the sampling region.

When the results of the study are evaluated in terms of the size classes, the highest ratio is 50x50 cm and below and similarly Ioakeimidis et al. (2014) reported that the highest size group in Constance was composed of medium sized class (<10x10 cm and <20x20 cm), and also Moncheva et al. (2016) reported similar results for Romania, Bulgaria and Turkey.

Moncheva et al. (2016) reported that marine litter at the coastal area were found to exceed about two times shelf density in the Black Sea and they explained this situation related most likely to the closeness to land-based sources, intensive human activities in the coastal marine area and accumulation on the bottom due to weaker currents (Barnes et al. 2009, Katsanevakis, 2009, Katsanevakis & Katsarou, 2004; Moncheva et al., 2016). It is possible that our results were high because our study was done in the coastal area. Topçu and Öztürk (2010) were found no relationships between depth and distance to shore in the Western Black Sea. However Ioakeimidis et al. (2014) found that marine litter is transported farthest from the shelf areas and accumulated in the deeper parts of Limassol Gulf.

In Europe have been started coordinated national or regional monitoring programmes for sea-floor litter in 2013 through experimental monitoring. In Guidance on Monitoring of Marine litter in European Seas is emphasised that the most widespread way to evaluate sea-floor litter distributions use opportunistic sampling and this type of sampling is generally together with regular fisheries surveys and

Table 2. Sea floor litter densities, proportional distribution and using methods in the Black Sea

Region	Method	Density	Proportional distribution of material types	Size class	References
Western Black Sea (Sinop)	Trawl	808±215 pieces/km <sup>2</sup>	Plastic 95.33%, Wood 2.33%, Cloth and Textile 2.33%,	A, B and C: 39%, D: 41%, E and F: 19%	This Study
Northwestern Black Sea (Romania, Bulgaria, Turkey)	Beam Trawl-ROV	6359±2015 pieces/km <sup>2</sup>	Plastic 68%	B: %67	Moncheva et al. 2014
Romania-Costanza	Trawl	291±237 pieces/km <sup>2</sup>	Plastic 45,2% Glass 22,4% Metal 21,9%	B and C: 66.2%, A: 22%, D and E: 3%	Ioakeimidis et al. 2014
Western Black Sea (Samsun)	Trawl	121-366 pieces/km <sup>2</sup>	Nylon 65.67% Plastic 19.4% Paper 4,48% Metal 4,48%	-	Terzi and Seyhan, 2013
Romania	Trawl	554,53 kg (Total)	Oil 48% Wood 37% Metal 5% Fishing gear 5% Plastic 2% Cloth and Textile 1%	-	Anton et al. 2013
Western Black Sea (İstanbul)	Trawl	541 pieces/km <sup>2</sup>	Nylon 79,6% Hard plastic 10,3% Others %4	-	Topçu and Öztürk, 2010
Western Black Sea (İstanbul)	Scuba diving	-	Glass, Plastic and Metal %77	-	STH, 2005; taken from BSC, 2009

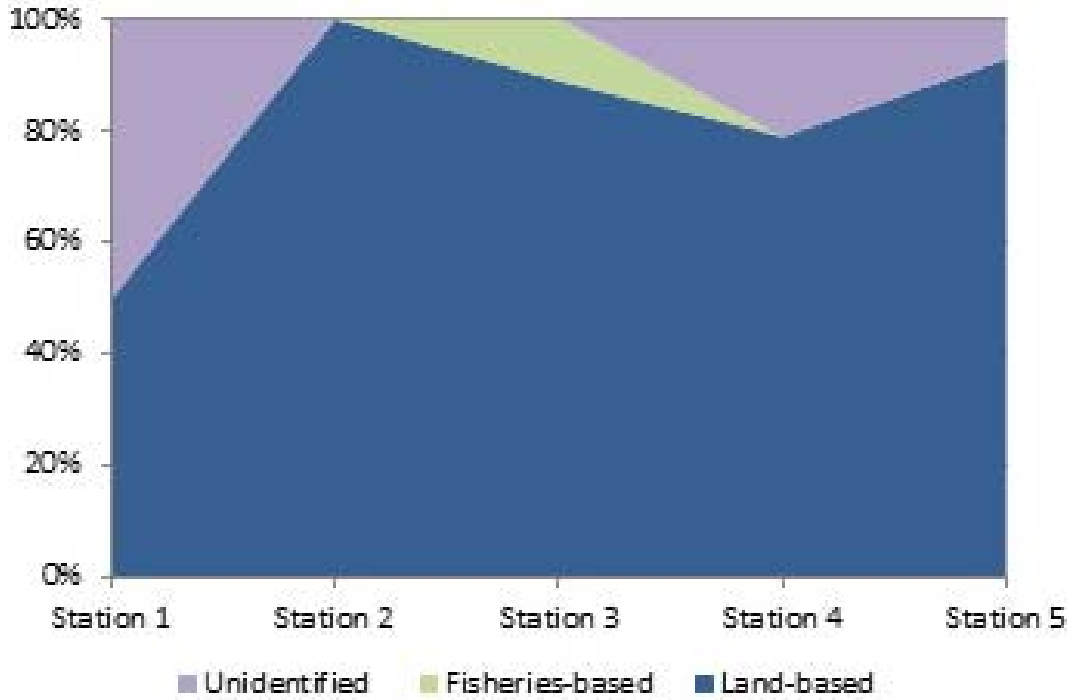


Figure 3. Composition of seafloor litter

The methodologies used in the studies investigated of seafloor litter in the Black Sea are compatible with each other. In the researches examinations were usually done using by trawl and just a few researches are different. In the study done on the shores of Istanbul, investigation was done by scuba diving and another one the applicability of Remotely Operated Vehicle (ROV) had been tested when investigating the litter densities of Romania, Bulgaria and Turkey.

The results show that there is densely marine litter pollution in study area and that the most common type of litter is plastic as in other studies in the Black Sea Region. Marine litter that has become a growing pollution problem in the world is also one of the main sources of pollution from a regional point. Regional and national monitoring and evaluation programs, including the proposed methods, the development of national and legal and administrative instruments should be implemented.

#### Acknowledgements

This study was presented as a poster presentation with Turkish abstract only in EKOLOJİ 2015 Symposium, 6-9 May 2015 Sinop, Turkey. It was supported by the Department of Hydrobiology of Fisheries Faculty, Sinop University.

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