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Spatial Distribution and Risk Assessment of Microplastics in Surface Sediment: A Case Study in the Gulf of Gemlik, Marmara Sea

Yüzey Sedimentlerinde Mikroplastiklerin Mekansal Dağılımı ve Risk Değerlendirmesi: Marmara Denizi Gemlik Körfezi Örneği

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Abstract: Microplastics have increasingly been recognized as a global pollutant due to their pervasive distribution and potential adverse impacts on marine ecosystems. Microplastics (MPs) were collected from surface sediments at five sites in the Gulf of Gemlik using density separation. The isolated MPs were subsequently identified and characterized with a stereomicroscope and fluorescence microscope. This study provides the first comprehensive assessment of microplastic pollution in the sediments of the Gulf of Gemlik, focusing on their abundance, spatial distribution, and potential ecological risks. The concentration of the MPs ranged from 2,200 to 6,400 items per kilogram of dry weight across the study sites. Fibers were the dominant shape type (58.4%), while black was the most prevalent color (26%). According to the ecological risk assessment, the sediments were classified as moderately to considerably contaminated with MPs. These findings contribute new insights into the occurrence and characteristics of microplastics in the surface sediments of the Gulf of Gemlik and establish a foundation for future research and management strategies aimed at mitigating microplastic pollution.

Keywords: Ecological risk, Gulf of Gemlik, microplastic, microscope examination, Nile Red.

Öz: *Mikroplastikler (MP'ler), yaygın dağılımları ve deniz ekosistemlerine potansiyel zararları nedeniyle giderek artan* şekilde *küresel bir kirletici olarak tanımlanmaktadır. Bu* çalışmada*, Gemlik Körfezi'ndeki beş istasyondan alınan yüzey sedimentlerinden mikroplastikler yoğunluk ayırma yöntemiyle ekstrakte edilmiş; ardından stereomikroskop ve floresan mikroskobu kullanılarak karakterize edilmiştir.* Çalışma*, Gemlik Körfezi sedimentlerindeki mikroplastik kirliliğine ilişkin bolluk, mekânsal dağılım ve potansiyel ekolojik risklere odaklanan ilk kapsamlı değerlendirmeyi sunmaktadır. Araştırma alanında MP miktarı, kuru ağırlık başına 2200 ile 6400 adet/kg arasında değişmektedir. Mikroplastiklerin baskın* şekli *lif (%58,4) ve baskın rengi siyah (%26) olarak belirlenmiştir. Kontaminasyon faktörü (CF) ve kirlilik yükü indeksi (PLI) esas alındığında, sedimentlerin orta düzeyde ila oldukça kirlenmiş olduğu saptanmıştır. Bu* çalışma*, Gemlik Körfezi yüzey sedimentlerinde mikroplastik varlığına dair yeni bulgular ortaya koymakta olup, gelecekte yapılacak araştırmalar ve mikroplastik kirliliğinin yönetimi ile azaltılmasına yönelik stratejiler için bir temel oluşturmaktadır.*

Anahtar Kelimeler: *Ekolojik risk, Gemlik Körfezi, mikroplastik, mikroskop incelemesi, Nil Red.*

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INTRODUCTION

Plastic has become a serious environmental issue, realized as a contaminant of emerging concern due to its potential effects on health and biodiversity (Ahmed et al., 2025; Sönmez et al., 2023). MPs are generally classified as plastic pieces or fragments smaller than 5 millimeters in diameter (Hartmann et al., 2019). Owing to their lightweight nature, corrosion resistance, and low cost, plastic materials are widely adopted in various aspects of daily human life (Wang et al., 2019; Sayed et al., 2021). Since the onset of widespread plastic materials in the 1950s, plastics have constituted an increasingly significant portion of marine solid waste, now accounting for up to 80% of ocean plastic observed in various studies (Kershaw, 2016). Microplastics (MPs) in the environment originate from both marine and land-based human activities, including the use of cosmetics, paints, and road materials, as well as inputs from residential areas (Horton et al., 2017), fishing, industrial processes, and the degradation of larger plastic debris (Horton et al., 2017; Kershaw et al., 2019).

Sediments are key repositories for investigating ecological contaminants like microplastics and heavy metals, offering a long-term storage of geochemical properties and structural sediment characteristics (Arslan Kaya et al., 2023). MPs are highly resistant to degradation, and tend to accumulate extensively in sediment layers (Niu et al., 2021), thereby increasing ecological risks (Yin et al., 2023). The deposition of microplastics in bottom sediments is affected by a range of factors, including the distance from contaminants sources, tidal activity, ocean circulation, seabed morphology, coastal landscape features, sediment structure, and water turbidity, among others (Uddin et al., 2021). Consequently, managing MP pollution in sediments is a critical concern that warrants greater research attention.

Numerous studies have investigated microplastic (MP) pollution in the sediments of the Marmara Sea (Yücedağ et al., 2022; Doğruyol et al., 2019; Baysal et al., 2020; Erkan et al., 2021; Belivermiş et al., 2021). Among these, Yücedağ et al. (2022) specifically focused on the Gulf of Gemlik; however, their sampling was limited to the eastern part of the gulf. To date, no comprehensive study has been conducted covering the broader Gulf of Gemlik, which is a densely populated area with significant levels of industrialization and anthropogenic activity, including swimming and camping.

This is the first study to investigate MPs in 5 different stations in the open area of the Gulf of Gemlik. These stations were specifically selected based on the circulation system of the Marmara Sea and the expected accumulation patterns of microplastics (MPs) associated with this system. Hence, this study aimed (1) to determine the abundance and spatial distribution of microplastics (MPs), (2) to identify their shapes, colors, and size ranges, and (3) to assess their potential ecological risks using the pollution load index and contamination factor.

METHODOLOGY

Geology of the Study Area

The southern shores of the Marmara Sea are composed of formations of different ages and characteristics, which are tectonically sutured together (Şengör et al., 1985). In the southern drainage basin of the Marmara Sea, the Pontide and Sakarya zones, the İzmir–Ankara suture belt, and sedimentary rocks presumed to be of Miocene age are present. The tectonic units in the study area and its surroundings include the Istanbul Zone, the Sakarya Zone, the Thrace Basin, the Rhodope-Istranca massif, the Kırşehir massif, and the Tauride block (Yılmaz et al., 1997; Okay et al., 1996). The basement rocks are widely exposed along the coastal region, including areas such as the Marmara Islands, the Kapıdağ and Armutlu Peninsulas, as well as Karabiga, Kurşunlu, Mudanya, and Gemlik (Vardar et al., 2014). Holocene units, primarily composed of clastic alluvial deposits, are predominantly exposed along the Kocasu River and its tributary system (Figure 1). The Gulf originated as a pull-apart basin during the late Pliocene to early Pleistocene, primarily formed by westward-trending dextral (right-lateral) strike-slip faults along the central segment of the North Anatolian Fault Zone (Yaltırak and Alpar 2002; Yaltırak et al., 2005).

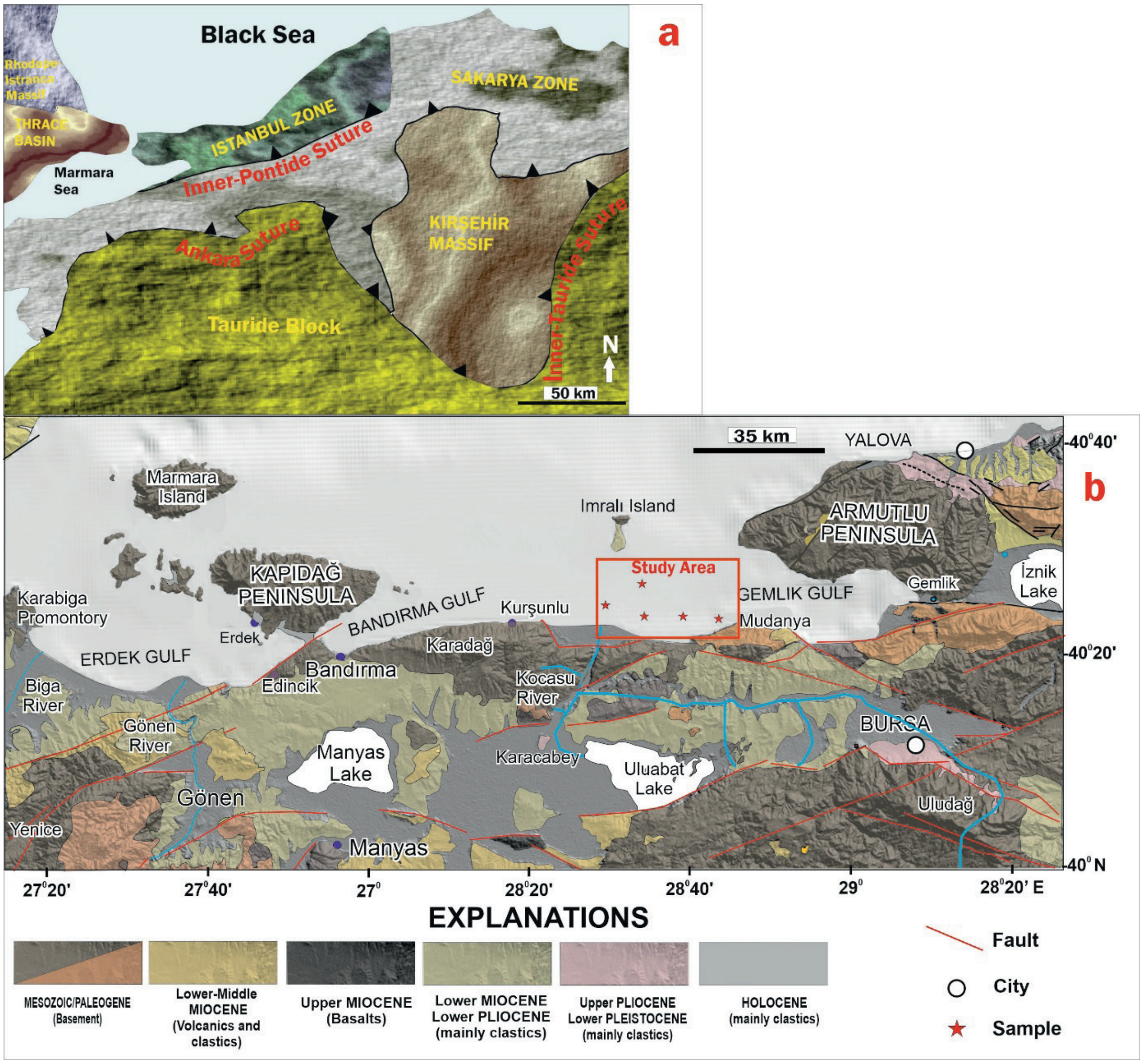

Figure 1. Generalized geological map of the study site and nearby regions (reproduced from; **a)** Okay and Tüysüz, 1999; **b)** Vardar et al., 2014).

Şekil 1. *Çalışma alanı ve çevresinin genelleştirilmiş jeolojik haritası (**a)** Okay ve Tüysüz, 1999 ve **b)** Vardar vd, 2014'ten uyarlanmıştır).*

Sampling

The study area is an area of approximately 165 km^2 surrounding from the southeastern to southwestern coasts between Mudanya and Kurşunlu, and from the northeastern to northwestern coasts between Armutlu and Imralı Island (Figure 2). Samples were collected from five distinct sites within the study area using a van Veen grab of R/V Alemdar II of Istanbul University. The sediments were collected in May 2019 from stations S1 (-32 m), S2 (-52 m), S3 (-34 m), S5 (-39 m), and S8 (-51 m) (Figure 2, Table 1).

Table 1. Sample depth and location coordinates.

Çizelge 1. *Örnek derinliği ve konum koordinatları.*

Station	Depth (m)	Coordinate
S1	-32 m	40°25’30.95”N 28°31’57.54”E
S2	-52 m	40°27’15.26”N 28°36’22.53”E
S3	-34 m	40°24’14.64”N 28°36’12.64”E
S5	-39 m	40°24’30.00”N 28°40’39.90”E
S8	-51 m	40°24’53.00”N 28°44’58.85”E

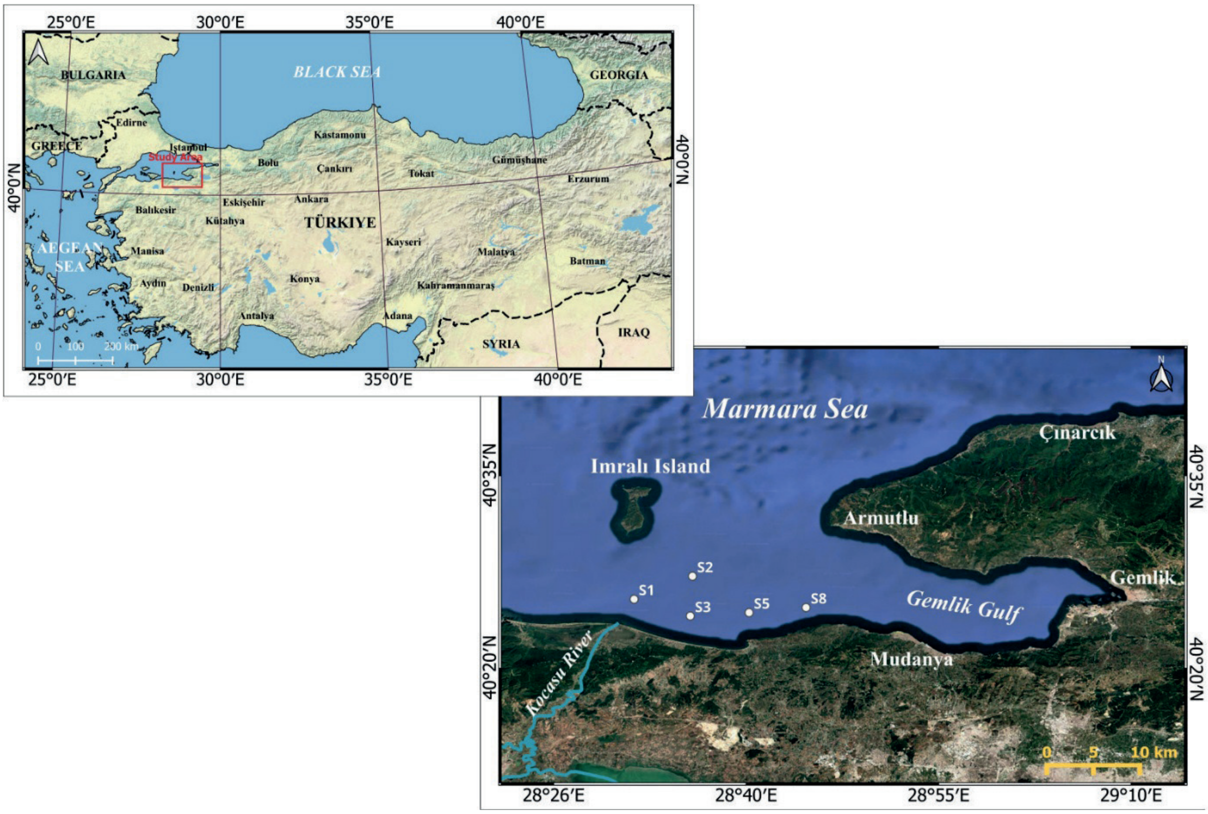

Figure 2. Map showing the geographic location and sampling sites of the surface sediments.

Şekil 2. *Yüzey sedimentlerinin coğrafi konumunu ve örnekleme noktalarını gösteren harita.*

Approximately 300 grams of each sample were obtained from each sampling site using stainless spoons and placed into pre-cleaned and labelled glass bottles to avoid contamination. Subsequently, the sediments were transferred to the Marine Geology Laboratory at the Institute of Marine Sciences and Management, Istanbul University, for further analysis. The study area is characterized by two water stratifications: a bottom layer with high salinity and density (36 ppt), and an upper layer with lower salinity and density (22 ppt) (Çağatay et al., 2003).

Total Organic Carbon (TOC), Grain Size

The coarse-grained fraction (gravel and sand) of the samples was analyzed using dry sieving, following the procedure outlined by McManus (1988). The sieve mesh sizes used in this analysis ranged from 2 mm to 0.063 mm, with an additional pan used to collect particles smaller than 0.063 mm.

Total organic carbon (TOC) was examined using the Walkley-Black method. This technique involves oxidizing the organic matter with potassium dichromate and titrating with ferrous ammonium sulphate, as described by Loring and Rantala (1992).

Microplastic Extraction and Analysis

Using an oven set at 60º C, the samples were dried until their weight stabilized. To remove macroplastic particles, the dried samples were filtered through a 5-millimeter sieve. Microplastics were then isolated using a density separation technique. For each sample, 5 grams of the sieved material were placed into a glass beaker, and 50 mL of a saturated sodium chloride solution (35 g/100 mL) was added. The mixture was stirred for 5 minutes to ensure homogenization and then sealed and left to settle overnight, following the approach explained by Erni-Cassola et al. (2017).

The following day, the supernatant was carefully transferred to a clean beaker, and 20 mL of 30% hydrogen peroxide was added to break down organic matter. The use of H_2O_2 for organic matter digestion is a standard step in microplastic research (Erni-Cassola et al., 2017). The solution was then warmed on a hot plate at 95 °C for 2 hours to aid the digestion process. To improve the recovery of microplastics, this entire extraction process was performed in triplicate for each sample, as recommended by Besley et al. (2017).

Pollution Load Index (PLI) and Contamination Factor (CF) of MPs

The Contamination Factor is defined as the ratio of the measured concentration of microplastics (MPs) in a sample (Ci) to a reference concentration (Co) (Equation 1). The reference values used in this study were derived from project FBA-2023-40344 (Standard Research Project funded by Istanbul University) and were determined from the uncontaminated or minimally contaminated sediment samples collected from core layers at depths greater than approximately 60 cm.

The Pollution Load Index describes the overall level of pollutants released into the environment and serves as an indicator of environmental contamination (Xu et al., 2018). Both CF and PLI were proposed by Tomlinson et al. (1980) to determine contamination levels in natural ecosystems. The PLI is a standardized tool commonly used to assess and compare pollution levels across different regions (Tomlinson et al., 1980). The PLI values in this study were calculated using Equations (2) and (3).

$$CFi = Ci/Co \quad (1)$$

$$PLIi = \sqrt{CFi} \quad (2)$$

$$PLI = \sqrt[n]{(PLI1 * PLI2 * PLI3 * \ldots * PLIn)} \quad (3)$$

Pollution levels were evaluated based on both the Contamination Factor (CF) and the Pollution Load Index (PLI). According to the CF classification, values of CF < 1 indicate low contamination, 1 ≤ CF < 3 indicate moderate contamination, 3 ≤ CF < 6 indicate considerable contamination, and CF ≥ 6 represent very high contamination. Similarly, PLI values less than 1 indicate no pollution, 1 ≤ PLI < 2 correspond to unpolluted to moderately polluted conditions, 2 ≤ PLI < 3 indicate moderate pollution, 3 ≤ PLI < 4 represent moderate to high pollution, 4 ≤ PLI < 5 indicate high pollution, and PLI > 5 denote severe pollution (Jafarabadi et al., 2017).

Statistical Analysis

Pearson's correlation coefficient was calculated to assess the linear relationship between grain size and microplastic abundance. The analysis was conducted using SPSS Statistics 21 for Windows (SPSS Inc., USA) after verifying that the data approximately followed a normal distribution. Pearson's correlation was chosen over Spearman's rank correlation due to the continuous nature of the variables. The resulting correlation coefficients were interpreted based on the direction and strength of the relationship. Statistical examination was applied by SPSS Statistics 21 for Windows (SPSS, Inc., USA).

RESULTS AND DISCUSSION

Grain Size Distribution and Total Organic Carbon (TOC)

The sediments at all study sites were predominantly composed of clayey mud. Grain size analysis revealed that the samples contained 0.1–1.2% gravel, 0.6–2.8% sand, 20.9–48.1% silt, and 51.1–77.6% clay (Table 2).

The lithology of the study area is generally characterized by massive greyish-green mud. The organic carbon content of the surface sediments at stations S1, S2, S3, S5, and S8 were 1.9%, 1.8%, 1.7%, 2.0%, and 2.0%, respectively (Table 2).

Table 2. Grain size value and TOC content of samples.

Çizelge 2. *Örneklerin tane boyu değerleri ve organik karbon içerikleri.*

Station	Gravel %	Sand %	Silt %	Clay %	TOC
S1	0.2	2.2	35.3	62.3	1.9
S2	1.2	1.6	21.5	75.6	1.8
S3	0.1	1.4	20.9	77.6	1.7
S5	0.4	2.8	32.0	64.9	2
S8	0.1	0.6	48.1	51.1	2
Mean	0.4	1.7	31.6	66.3	1.8

Distribution and Abundance of Microplastics

In this study, the abundance of MPs in surface sediment samples collected from the southwestern part of the Gulf of Gemlik is shown in Figure 3. Microplastic concentrations varied among samples from the open area of the gulf. The abundance of MPs ranged from 3,800 to 8,600 items per kilogram of dry weight (d.w.) under the stereomicroscope, while under the fluorescence microscope it ranged from 2,200 to 6,400 items/kg d.w. (Table 3). The mean MP abundance across all sites was 4,320 items/kg d.w. Among the sampling stations, MP concentrations (in items/kg d.w.) decreased in the following order: S1 (6,400) > S3 (6,000) > S5 (4,000) > S2 (3,000) > S8 (2,200).

In the case of sampling points, the lowest value was observed at S8 (2200 MPs/kg), whereas the highest value was observed at S1 (6400 MPs/kg; close to the Kocasu River) (Figure 3). Sample sites S1 and S3, collected near the Kocasu River, had the highest number of MPs. In contrast, sites S5 (4000 MPs/kg) and S8, which are the farthest from the river, had the lowest MP count

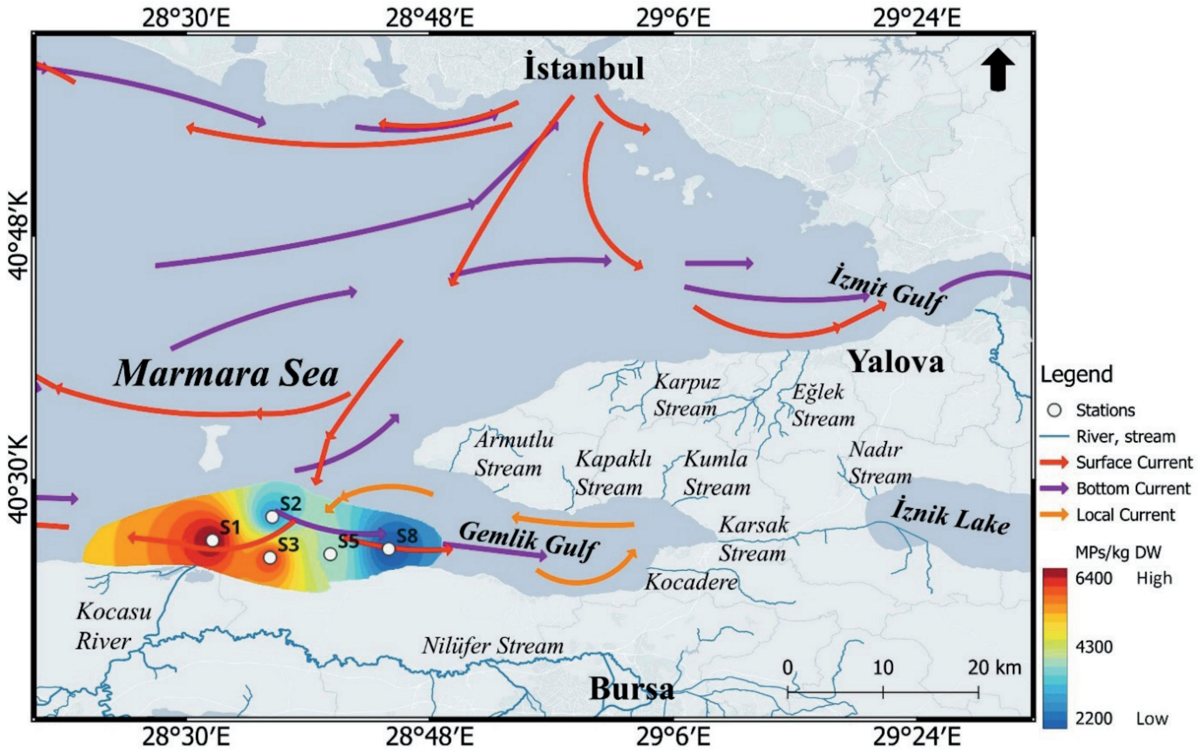

Figure 3. Spatial distribution of microplastic abundance and the current circulation system in the Marmara Sea (modified from Beşiktepe et al., 1994).

Şekil 3. *Marmara Denizi'ndeki mikroplastik bolluğunun mekânsal dağılımı ve akıntı sistemi (Beşiktepe et al., 1994 den uyarlanmıştır).*

Table 3. Abundance of MPs in surface samples from the study area.

Çizelge 3. *Çalışma alanındaki yüzey örneklerinde mikroplastik bolluğu.*

Sample no	Stereomicroscope examination			Fluorescence microscope examination		
	Item/kg	Percentage of fragment	Percentage of fiber	Item/kg	Percentage of fragment	Percentage of fiber
S1	3800	52.6	47.4	6400	61.9	38.1
S2	6400	71.9	28.1	3000	26.7	73.3
S3	6000	73.3	26.7	6000	20.0	80.0
S5	8600	79.1	20.9	4000	35.0	65.0
S8	4600	65.2	34.8	2200	27.3	72.7
Total	29400			21600		
Mean	5880	68.4	31.6	4320	34.2	65.8

Human actions and agricultural practices can contribute to the presence of plastic debris and other pollutants in rivers (Uddin et al., 2021). A gradual increase in microplastic abundances is observed as the sampling site approaches the Kocasu River. Accordingly, the lower concentration of microplastics farther from the river could be linked to a decreased flow rate and the sea current system, which facilitated the accumulation of plastic particles.

Compared with the several sediments from the Marmara Sea, the MP abundance in the study area was comparatively high. Belivermiş et al. (2021) reported 2867 particles/kg in sediments from the Golden Horn. Other studies conducted in the Marmara Sea reported varying microplastic (MP) concentrations. For example, Erkan et al. (2021) reported 1,957 MPs/kg, Baysal et al. (2020) found concentrations ranging from 13 to 5,100 particles/kg, and Mutlu et al. (2024) reported values between 195 and 226 MPs/kg.

MPs Shape

According to the MPs shapes in the study area, we categorized the collected MPs into two types: fragment and fiber. MPs were observed under a fluorescent microscope using the Nile Red staining technique. The images of microplastics shapes were examined (Figure 4). Fiber has the appearance of being slim and long, whereas fragment is irregular in shape and has a certain thickness. The fibers were from 0.05 mm to 4 mm, whereas the fragments ranged from 0.05 mm to 1 mm in length.

Regarding the shape of microplastics, previous studies (Belivermiş et al., 2021; Matsuguma et al., 2017) reported that fragments are the dominant form, followed by fibers, films, and spherical particles in decreasing order. However, there appears to be some inconsistency in the literature concerning the predominant microplastic shape. While several studies (Brandon et al., 2019; Xue et al., 2020) identified fibers as the most common type, others (this study; Belivermiş et al., 2021; Matsuguma et al., 2017) reported a dominance of fragments.

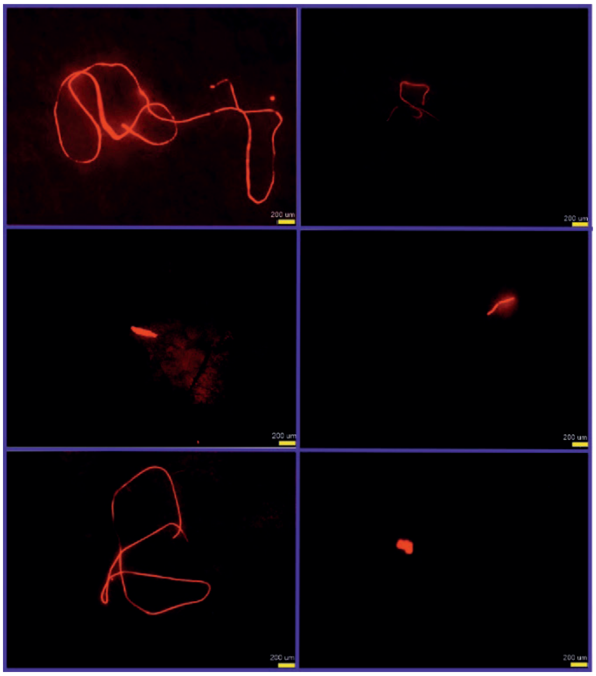

Figure 4. Images of microplastics under a fluorescence microscope.
Şekil 4. *Mikroplastiklerin floresans mikroskop altında görüntüleri.*

In this study, fiber-shaped microplastics (58.4%) were the dominant type at all stations except for station S1 (Figure 5). At station S1, fragments were the most abundant MP form, accounting for 3,960 items/kg. The higher proportion of fragments compared to fibers at this site is likely related to the influence of the Kocasu River, which transports larger plastic debris through its drainage system. Nevertheless, fibers were also present in considerable amounts at S1, with a concentration of 2,440 items/kg. Film and foam particles were not observed under the stereomicroscope, probably due to their low density, which prevents them from settling and accumulating in sediments.

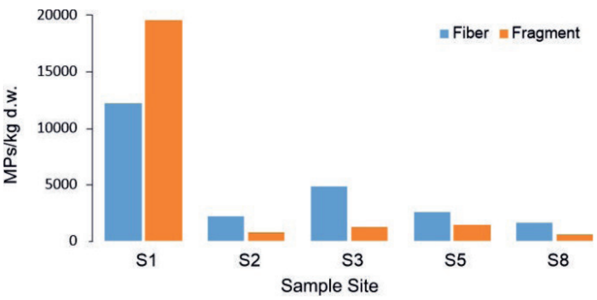

Figure 5. Abundance of MP shapes among sampling sites.

Şekil 5. *Örnekleme noktaları arasında MP'lerin şekilsel bolluğu.*

The identified MPs were transparent, black, gray, navy, brown, blue, and other in color (Figure 6). The predominant colors of the microplastics were black, gray, and transparent, comprising 26%, 24%, and 23%, respectively, in descending order of abundance.

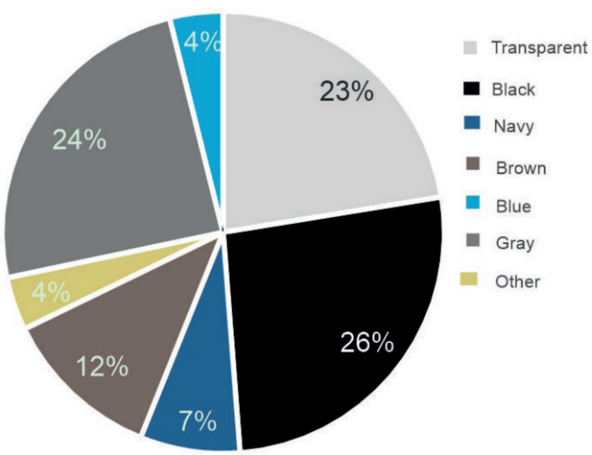

Figure 6. The overall percentage of MP colors in the study area.

Şekil 6. *Çalışma alanındaki mikroplastik renklerinin yüzdesel dağılımı.*

Pollution and Sources

According to Pearson's correlation, a strong positive correlation was observed between fine-grain sediment (silt and clay) and MP abundance (Table 4). These results support previous studies (Enders et al., 2019, Mendes et al., 2021), which also reported a similar relationship. However, contrasting results were reported by other studies (Martins and Sobral, 2011; Alomar et al., 2016; Blaskovic et al., 2017), which found no significant correlation between fine sediment fractions and MP concentrations. The main factor contributing to the elevated microplastic (MP) pollution observed at sites S1 and S3 is the influence of the Kocasu River, as evidenced by the substantial spatial variation in MP concentrations. According to Arslan Kaya et al. (2022), the primary terrestrial inputs to the Gulf of Gemlik originate not only from human activities but also from the Kocasu River, which flows into the gulf from the south. This finding is consistent with, and reinforces, the results of the present study.

Table 4. Pearson correlation matrix showing the relationship between sediment grain size and microplastic content.

Çizelge 4. *Sediment tane boyu ile mikroplastik içeriği arasındaki ilişkiyi gösteren Pearson korelasyon matrisi.*

	Clay	Silt	Sand	Gravel	MP
Clay	1				
Silt	-1.00	1			
Sand	0.24	-0.31	1		
Gravel	0.46	-0.5	0.15	1	
MP	0.42	0.39	-0.39	-0.38	1

The Kocasu River comprises of numerous tributaries, the most prominent of which is the Nilüfer Stream (Arslan Kaya et al., 2022). This tributary transports substantial volumes of domestic and industrial wastewater from the city of Bursa, thereby contributing to the contamination of the southern shelf region of the Marmara Sea (Sarı, 2008). Bursa hosts extensive industrial zones, with key sectors including leather production, textiles, metal processing, rubber manufacturing, and plastics (Arslan Kaya et al., 2022). The presence of fibers is likely largely due to the breakdown of agricultural materials and the discharge of wastewater containing textile fibers from clothing (Claessens et al., 2011). Moreover, plastic fibers may also originate from fishing gear, airborne deposition, and surface water runoff (Browne et al., 2011). Therefore, the high content of microplastics at site S1 is not surprising, given that it reached up to 6400 MPs/kg.

The CF values indicated low to considerable levels of microplastic contamination across all sampling sites in the Gulf of Gemlik (Figure 7). A descending trend in CF values was observed in the following order: S1 > S3 > S5 > S2 > S8. Moderate MP pollution was commonly detected in sediments from sites S2, S5, and S8, likely associated with beach-related activities such as swimming and camping, as well as inputs from nearby urban areas, agricultural runoff, household waste, and small-scale fishing operations (e.g., nets, ropes, and ship debris). The higher MP concentrations and considerable contamination observed at sites S1 and S3 are strongly influenced by the discharge of the Kocasu River. According to Arslan Kaya et al. (2022), the Kocasu River transports approximately 614,000 tons of suspended particles per year (Ergin et al., 2008), representing a substantial pollution load derived from agricultural and industrial regions entering the Gulf of Gemlik.

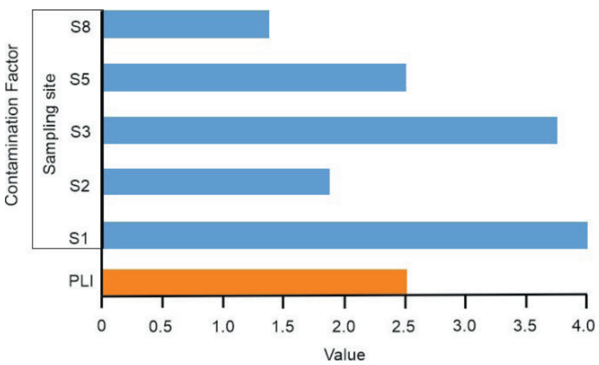

Figure 7. CF and PLI values of surface sediments.

Şekil 7. *Yüzey sedimentlerin CF ve PLI değerleri.*

The Pollution Load Index (PLI) for the study area was calculated as 2.5, falling within the range of 2 < PLI < 3, which corresponds to a moderate level of MP pollution. Microplastic contamination in sediments is of concern because these particles can be ingested by fish and other aquatic organisms, potentially causing adverse effects on their health and bioaccumulating through the food web.

CONCLUSIONS

This study presents the first comprehensive assessment of microplastic pollution in the southwestern part of the Gulf of Gemlik, covering the coastal area from Kurşunlu to Mudanya. Fibers were identified as the most dominant shape (58.4%), followed by fragments (42.6%). A positive relationship was observed between MP abundance and sediment grain size. The calculated Contamination Factor (CF) values clearly indicated that all sampling locations in the study area were contaminated with MPs. Overall, this research provides essential baseline data on MP abundance and characteristics in the region, offering a valuable reference for future monitoring programs and management strategies aimed at mitigating microplastic pollution.

GENİŞLETİLMİŞ ÖZET

Bu araştırma, Marmara Denizi'nin güneybatısında yer alan Gemlik Körfezi'nde seçilen beş farklı noktadan alınan yüzey sedimanlarındaki mikroplastik (MP) kirliliğini değerlendirmiştir. Sedimanlar ağırlıklı olarak killerden oluşan çamurlardan meydana gelmekte olup, tane boyutu analizleri %0,1-1,2 çakıl, %0,6-2,8 kum, %20,9-48,1 silt ve %51,1-77,6 kil oranlarında değişiklik göstermektedir. Organik karbon içeriği ise %1,7 ile %2,0 arasında değişmektedir. Mikroplastiklerin yoğunluğu kuru sediman kilogramı başına 2200 ile 6400 adet arasında bulunmuş olup, en yüksek yoğunluk Kocasu Nehri'ne yakın bölgelerde tespit *edilmiştir. Bu durum, nehir kaynaklı kirliliğin Gemlik Körfezi'ndeki mikroplastik birikimini önemli ölçüde etkilediğini göstermektedir.*

Mikroplastikler şekil açısından iki ana gruba ayrılmıştır: lifler ve parçacıklar. Genel olarak lifler (%58,4) hakimken, nehir kenarındaki S1 örneklemesinde parçacıklar daha fazla görülmüştür. Lifler 0,05 mm ile 4 mm arasında uzunlukta olup, parçacıklar ise 0,05 mm ile 1 mm arasında değişmektedir. Renk dağılımında siyah, gri ve şeffaf mikroplastikler en yaygın olanlardır. Yapılan korelasyon analizleri, ince taneli sediman (silt ve kil) oranı ile mikroplastik yoğunluğu arasında pozitif ve güçlü bir ilişki olduğunu ortaya koymuştur. Bu da ince taneli sedimanların mikroplastik birikimi için uygun ortam sağladığını göstermektedir.

Mikroplastik kirliliğinin yüksek olduğu S1 ve S3 örneklerinde Kocasu Nehri ve onun önemli kollarından biri olan Nilüfer Deresi'nin endüstriyel ve evsel atıklarla birlikte önemli bir kirlilik kaynağı olduğu belirlenmiştir. Bursa kentinin deri, tekstil, metal işleme, plastik ve kauçuk gibi yoğun endüstriyel faaliyetleri, bölge sularına önemli ölçüde kirlilik taşımaktadır. Ayrıca, tarımsal faaliyetler ve kentsel atıklar da mikroplastik kirliliğine katkıda bulunmaktadır.

Kirlilik faktörü (CF) analizleri, Gemlik Körfezi'nde düşük ile yüksek arasında değişen kirlilik seviyelerini göstermiştir. CF değerlerine göre kirlilik sıralaması S1 > S3 > S5 > S2 > S8 şeklindedir. Bölgedeki Kirlilik Yük Endeksi (PLI) ise 2,5 olarak hesaplanmış ve bu da orta seviyede mikroplastik kirliliğine işaret etmektedir.

Bu çalışma, Gemlik Körfezi güneybatısında mikroplastik kirliliği üzerine yapılan ilk detaylı araştırma olma özelliğini taşımakta olup, bölgedeki mikroplastik yoğunluğuna dair temel veri sağlamaktadır. Elde edilen bulgular, mikroplastiklerin sucul ekosistemler üzerindeki olası olumsuz etkilerini vurgulamakta ve gelecekte yapılacak izleme ve yönetim çalışmaları için önemli referans niteliği taşımaktadır.

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