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Determination of the presence of biomicroplastics in common carp (*Cyprinus carpio*) in Almus dam lake

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Abstract: This study aimed to investigate the gastrointestinal systems of carp (*Cyprinus carpio*) in Almus Dam Lake for microplastic ingestion. For this purpose, 30 carp specimens were purchased from local fishermen in Almus in July 2025. Morphometric measurements of the fish were taken, and their gastrointestinal systems were analyzed to determine abundance (number of microplastics per individual) and characterization (shape, color, and size) of microplastics. The percentage of fish contaminated with microplastics was 100%. The average number of microplastics per individual was calculated to be 12.66±7.55 MP/individual. Microplastic identification was performed using a stereo microscope for visual inspection. It was determined that the vast majority of microplastics were in fibrous form (72.11%), and the highest proportion in the color distribution was black, blue, and red microplastics. According to size distribution classification, the majority were smaller than 5 mm and were classified as microplastics. Furthermore, a statistically significant positive correlation was found between total length and the number of microplastics (Spearman's $\rho = 0.42$, $p < 0.05$). The study confirms the presence of microplastic pollution in the Almus dam reservoir and shows that carp are exposed to this pollution. This study contributes to the literature as it is one of the first microplastic studies conducted on fish in the Almus Dam Lake ecosystem. It is recommended that more effective solid waste management and monitoring mechanisms be implemented to reduce microplastic input into the Almus Dam Lake basin, particularly from fishing waste and human-induced pollution. Furthermore, regular biological monitoring programs based on standardized protocols should be implemented to track temporal changes in microplastic pollution in aquatic organisms.

Keywords: Bioaccumulation, Freshwater fish contamination, Ingestion, Gastrointestinal tract

Almus baraj gölü Sazan (*Cyprinus carpio*) balıklarının gastrointestinal sistemlerinde mikroplastik varlığının belirlenmesi

Öz: Bu çalışmanın amacı, Almus Baraj Gölü'nde sazan balıklarının (*Cyprinus carpio*) gastrointestinal sistemleri mikroplastik yutulması açısından incelenmiştir. Bu amaçla, Temmuz 2025'te Almus'taki yerel balıkçılardan 30 adet sazan örneği satın alınmıştır. Balıkların morfometrik ölçümleri yapılmış, mikroplastiklerin bolluğunu (birey başına mikroplastik sayısı) ve karakterizasyonunu (şekil, renk ve boyut) belirlemek için sindirim sistemleri analiz edilmiştir. Mikroplastiklerle kontamine olmuş balıkların oranı %100 olarak belirlenmiştir. Birey başına düşen mikroplastik miktarı ortalaması 12.66±7.55 MP/birey olarak hesaplanmıştır. Mikroplastiklerin tanımlanması, görsel inceleme için stereo mikroskop kullanılarak gerçekleştirilmiştir. Mikroplastiklerin büyük çoğunluğunun lif formunda olduğu (%72.11), renk dağılımında ise en yüksek oranın siyah, mavi ve kırmızı mikroplastiklere ait olduğu belirlenmiştir. Boyut dağılım sınıfına göre çoğunluğun 5 mm'den küçük olduğu ve mikroplastik sınıfına girdiği belirlenmiştir. Ayrıca, toplam boy ile mikroplastik sayısı arasında pozitif yönde istatistiksel olarak anlamlı olduğu saptanmıştır (Spearman korelasyon katsayısı, $\rho = 0.42$, $p < 0.05$). Almus baraj gölünde mikroplastik kirliliğinin varlığını doğrulamakta ve sazan balıklarının bu kirliliğe maruz kaldığını göstermektedir. Almus Baraj gölü ekosisteminde balıklar üzerinde gerçekleştirilen ilk mikroplastik çalışmalarından biri olması nedeniyle literatüre katkı sağlamaktadır. Almus Baraj Gölü havzasına, özellikle balıkçılık atıkları ve insan kaynaklı kirlilikten kaynaklanan mikroplastik girişini azaltmak için daha etkili katı atık yönetimi ve izleme mekanizmalarının uygulanması önerilmektedir. Ayrıca, sucul organizmaların mikroplastik kirliliğindeki zamansal değişimleri izlemek için standartlaştırılmış protokollere dayalı düzenli biyolojik izleme programları uygulanmalıdır.

Anahtar kelimeler: Biyolojik birikim, Tatlı su balıkları kirliliği, Yutulma, Gastrointestinal sistem

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1. Introduction

Plastics are synthetic materials composed of long molecular chains called polymers. They are widely used in many industrial and consumer applications due to their durability, lightness, flexibility, and generally low cost (Andrady, 2003). The global spread of plastic waste and its environmental impacts is becoming increasingly concerning. Global plastic production reached 390.7 million tons in 2023. This increase is attributed to the intensive use of plastic products, increased production, and inadequate waste management practices (Banaee et al., 2023).

The presence of plastic residues was first detected in coastal waters in the 1970s (Carpenter and Smith, 1972). The term “microplastics” was first used by Thompson et al. (2004) to describe plastic particles with an effective size of less than 5 mm. Their small size allows for their more widespread distribution and penetration into various ecosystems (Barnes et al., 2009). Microplastics have serious impacts on the environment and ecosystems; they are considered a significant problem that requires attention (Çağlayan and Aytan, 2020).

In subsequent years, records of microplastic consumption by fish have increased worldwide (Hanachi et al., 2021; Alak et al., 2023; Banaee et al., 2023). Today, microplastic ingestion by fish is assessed based on feeding behavior, habitat characteristics, and environmental pollution levels.

Research on the presence of microplastics in freshwater has also gained increasing importance in recent years. These studies have shown the presence of microplastic pollution in various freshwater ecosystems, from rivers to lakes and from streams to dams (Lechner et al., 2014; Mani et al., 2015; Zhang et al., 2015; Estahbanati and Fahrenfeld, 2016; Anderson et al., 2017; Di and Wang, 2018; Terzi, 2023). In Türkiye, microplastic research has primarily focused on marine ecosystems (Güven et al., 2017; Gürkan % Yüksek, 2022; Terzi et al., 2025; Şimşek, 2025). However, although studies conducted in freshwater ecosystems have increased recently, research on microplastic accumulation, particularly in reservoir fish species, remains relatively limited (Atıcı et al., 2021; Atamalp et al., 2022; Gedik and Atasaral, 2022; Turhan, 2022; Terzi, 2023).

The effects of microplastics on public health remain unclear, and reliable risk assessments require precise evaluation of environmental exposure. Therefore, examining the presence of microplastics in fish living in their natural environment is of great importance in evaluating the potential consequences of environmental exposure on human and animal health (Li et al., 2015). In freshwater systems, biological monitoring of microplastics is crucial for evaluating their spatial distribution, movement pathways, environmental fate, and overall impacts on ecosystem health (Erdoğan, 2025). Fish represent freshwater organisms of significant ecological and economic importance and are widely recognized as sensitive bioindicators of microplastic pollution in aquatic systems (Böyükalan and Yerli, 2023). This project will be one of the first studies to examine the presence of microplastics in fish in Almus Dam Lake.

Carp, an omnivorous bentopelagic species with a diverse diet including plankton, crustaceans, insects, aquatic plants, fish larvae, and small fish (Hoole et al., 2011), is preferred because of its high likelihood of exposure to microplastics of different types and sizes. The tendency of microplastics to accumulate at higher concentrations in sediments, particularly for bentopelagic species, poses a greater threat to demersal fish than to pelagic species (Tepe et al., 2024). This is supported by data showing that microplastic uptake by bentopelagic fish may be higher in freshwater organisms than in marine fish (Esmeray and Armutcu, 2020). Conducting microplastic analyses in a widely distributed and economically important freshwater fish species, such as carp, offers a unique methodological contribution, given the limited studies in this area and the high consumption rates in the region.

This research aims to determine whether microplastics are present in the digestive systems (GI) of carp in Almus Dam Lake. This will provide a broader understanding of microplastic pollution in the region and highlight its potential risks to the ecosystem and public health. Given that water resources such as Almus Dam Lake are used for agriculture and electricity generation, the findings will have significant implications for environmental management policies.

2. Materials and Methods

2.1. Research Area

Almus Dam Lake is a large freshwater reservoir on the Kelkit River within Tokat province. Built in 1966, the dam provides water to surrounding settlements and is used for agricultural irrigation and electricity generation. The dam lake has a surface area of approximately 31.3 km^2 and harbors rich biodiversity, particularly freshwater species such as trout, catfish, and carp (Buhan et al., 2010, Figure 1). Furthermore, the lake holds a significant place in Turkey's inland fisheries with an annual aquaculture capacity of several thousand tons (Anonymous, 2015). Due to agricultural activities, aquaculture, and fishing in its surroundings, the lake is at risk of microplastic pollution, making it an important research area for regional ecosystem health

In July 2025, a total of 30 adult carp specimens (total length: 380–460 mm; body weight: 850–1500 g) were collected from local fishermen in Almus Dam Lake during the fishing season. This sampling approach is described as convenience (opportunistic) sampling because samples are collected based on available accessibility, rather than according to a predetermined sampling design. During the sampling process, individuals of varying sizes and weights were included to represent the existing catch composition. Morphometric characteristics (weight, total length, mouth width, and depth) of the specimens were measured. The sample size was determined by considering sample sizes used in similar studies described in the literature (Rochman et al., 2015; Lusher et al., 2016; Bessa et al., 2018).

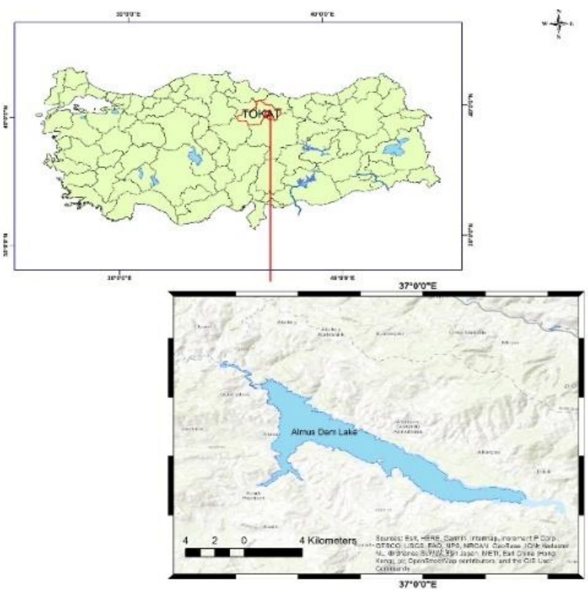

Figure 1. Map of Almus Dam Lake

2.2. Microplastic analysis

Carp specimens were individually dissected in a stainless steel tray, the GI was removed, and they were then transferred to glass beakers for further processing and sealed with tin foil. The beakers were sealed with tin foil and weighed. For GI samples in glass beakers, 20 mL of 30% H_2O_2 (hydrogen peroxide) was added per gram of GI tissue; the beakers were sealed with tin foil and incubated at 42 °C for 24-48 hours to digest the organic material (Li et al., 2020; Kılıç, 2022). After digestion was completed, a high-density NaCl solution (1.2 g/mL) was prepared to separate microplastics from the digested soft tissue matrix through density separation. Each glass beaker was homogenized by adding 800 mL of filtered NaCl solution and then left to precipitate at room temperature for 24 hours (Li et al., 2020; Hossain et al., 2019). Next, a filtration process (45 μm stainless steel sieve) was performed, and the plastic pellets remaining on the sieve were washed with distilled water for analysis (Hossain et al., 2019). The washed samples were placed in glass Petri dishes, transferred onto filter papers (Whatman Membrane Filters, 0.45 μm), and dried in an oven at 40 °C for 24-48 hours to remove excess water (Hossain et al., 2019).

In the identification of microplastics, microplastics on filter papers were first examined under a stereomicroscope at 5x magnification, and preliminary identification was performed based on morphological criteria suggested in the literature (such as absence of cellular structure, lack of organic material, metallic reflection, and unnatural morphology) (Khan et al., 2020). Then, a more detailed second stage was performed under a light-dissection microscope at 40x magnification to evaluate each sample. In this stage, it was observed whether the microplastics had unnatural colors (such as bright blue) and shapes (such as sharp-edged fragments), and the microplastics were re-confirmed according to additional criteria determined by Horton et al. (2018) (e.g., lack of cellular structure, fibers of homogeneous width, remaining intact when pulled with tweezers). Size measurements of microplastics were performed using ImageJ image analysis software from microscope images (Schneider et al., 2012), and size classification was determined according to generally accepted size classes: <0.3 mm, 0.3–0.5 mm, 0.5–1 mm, 1–2.5 mm, 2.5–5 mm, and >25 mm (Hidalgo-Ruz et al., 2012; Koelmans et al., 2015; Lusher et al., 2017). According to the classification proposed by Tanaka and Takada (2016), microplastics were categorized as fibers, fragments, films, pellets, foams, and beads.

2.3. Contamination Control of Microplastics

During sample transport, plastic-free containers and packaging materials were used to reduce the risk of contamination. During the experimental procedures, all laboratory equipment was repeatedly washed with pure water, and work surfaces were carefully disinfected using alcohol (Li et al., 2015). All solutions (pure water, saline solution, and hydrogen peroxide) were filtered through a 1.2 µm GF/C Whatman filter paper before use. Throughout the laboratory work, measures to prevent contamination were meticulously implemented, with nitrile gloves and cotton lab coats used continuously. Where possible, procedures were performed inside a laminar flow cabinet. In addition, all samples were preserved by covering them with aluminum foil when not being processed, and the experimental process was completed as quickly as possible. To assess potential contamination, a control group was created in which all analytical procedures applied to the samples were repeated. Microscopic examination of the control group revealed a negligible number of microplastic particles. However, it should be noted that microplastics, especially fibrous ones, can be easily contaminated through atmospheric transport, which is considered a potential source of uncertainty in microplastic studies (Allen et al., 2019).

2.4. Data Analysis

The following formula was used to determine the frequency (FO) of plastic particles:

$$FO\% = (Ni/N) \times 100 \quad (1)$$

Here, FO% represents the ratio of individuals containing microplastics to the total number of individuals; Ni represents the number of gastrointestinal tract (GI) samples in which microplastics were detected; and N represents the total number of GI samples examined. This ratio is a key indicator for assessing the prevalence of microplastic exposure in the studied fish population.

Detected microplastics were classified according to their morphological characteristics, specifically shape, color, and size categories. The frequency of occurrence (%) and the average number of particles per individual were calculated separately for each category. Thus, the distribution profile of microplastic types in the GI was determined. Appropriate statistical tests were used to assess the relationship between microplastic presence and biological variables, such as fish length and weight. First, the normality of the variables' distributions was evaluated using the Shapiro-Wilk test. Based on the results, parametric or non-parametric tests were chosen. All analyses were performed using SPSS software with a statistical significance level of $p<0.05$.

3. Results and Discussion

A total of 380 microplastics were detected in all 30 samples examined (100%) (Figure 2). The number of microplastics per individual ranged from 5 to 42 MP/individual, with an average of 12.66±7.55 MP/individual (Table 1). While many studies in freshwater and marine ecosystems have reported lower percentages of microplastics (Lusher et al., 2016; Bellas et al., 2016; Giani et al., 2019; Aytan et al., 2021), the 100% reported in this study is noteworthy. This suggests that regional pollutant pressure may be relatively high.

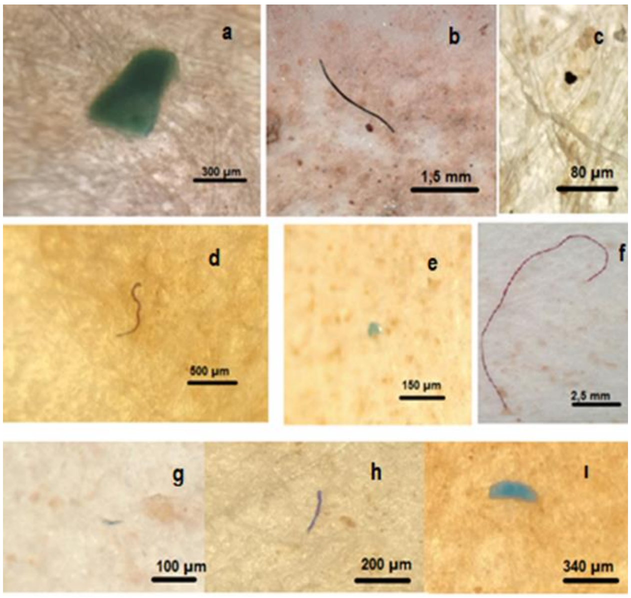

Figure 2. Microscopic images of microplastic samples: a (green), c (black), e (transparent), ı (blue) represent fragment, b (black), d (red), f (red), g (blue), h (purple) represent fiber microplastic types. Images a and c were obtained with a light microscope at 40× magnification, while the other images (b, d, e, f, g, h, ı) were obtained with a stereo microscope at 5× magnification. The images were selected to reflect the characteristics of the samples analyzed.

Some studies conducted in seas and bays have reported microplastic amounts per fish as 4 MP/individual in the Black Sea, 1.38 MP/individual in the Mediterranean Sea, and 2.1 MP/individual in Xiangshan Bay (Giani et al., 2019; Wu et al., 2019; Aytan et al., 2021). These values are considerably lower than the average of 12.66±7.55 MP/individual determined in our study. In the marine environment, hydrodynamic processes, wave action, and the open structure of the system facilitate the dilution and transport of microplastics; while in stagnant water systems such as reservoirs, limited water circulation and dominant sedimentation processes increase the retention of plastic particles in the environment (Peng et al., 2017). In addition, plastics entering dam lakes can accumulate within the system via river inputs and surface runoff (Alimi et al., 2018).

Studies in freshwater systems have also reported significant differences in microplastic concentrations. For example, in pearl mullets living in Lake Van, an average of 34 ± 13 MP/individual was detected, which is higher than the average in our study. This situation has been attributed to microplastics being retained more within the system due to the lake's closed-basin nature and low flow rate (Atıcı et al., 2021). In contrast, in Lake Çernek, microplastics were detected in 90% of pearl mullets, with an average of 2.87 ± 0.27 MP particles per fish (Terzi, 2023). This value is significantly lower than the average observed in Almus. Similarly, an average of 0.41 MP/individual microplastics per fish was detected in Sürgü Dam (Turhan, 2022). These differences indicate that the hydrodynamic characteristics of water systems, basin structure, water renewal rate, and the level of human-induced impact are factors affecting microplastic accumulation.

Table 1. Morphological data of the samples and the average number of plastics obtained from the digestive systems of fish.

Average weight (g) ± SD	Average total length (mm) ± SD	Average mouth width (mm) ± SD	Average mouth depth (mm) ± SD	Mean gastrointestinal volume (ml) ± SD
1120±150	405.30±20.58	28.01±4.38	29.08±4.01	53.86±13.21

Table 1 presents the mean and standard deviation values of morphometric measurements and GI content volumes for 30 carp samples. Accordingly, the average weight of the fish was determined to be 1120±150 g, and the average length was 405.30±20.58 mm. In mouth morphology measurements, the average mouth width was determined to be 28.01±4.38 mm, and the mouth depth was 29.08±4.01 mm. The average GI volume was 53.86±13.21 ml (Table 1).

The relationships between the morphological characteristics of carp and the MP abundances determined in GI were statistically examined. Because some variables did not meet the assumption of normality and the sample size was limited, a non-parametric Spearman correlation analysis was preferred for all variables to ensure consistency across analyses (Table 2).

Table 2. Normality test (Shapiro–Wilk) results

Variable	**Shapiro-Wilk Statistic**	**p-value**
Weight	0.938	0.079
Total length	0.907	0.013*
Mouth Width	0.969	0.513
Mouth Depth	0.964	0.388
Total Stomach Volume	0.964	0.384
Total Microplastic Count	0.779	0.000*

*Significant at $p < 0.05$

According to the analysis results, a significant positive correlation was found between the number of microplastics (MP) and total length (Spearman correlation coefficient (ρ) = 0.42, $p < 0.05$). An outlier with approximately 42 MPs was also detected in the dataset. This value is explained by a combination of factors, including the individual's high stomach fullness, the hydrodynamic structure of the aquatic system, the fish's feeding strategy, and regional anthropogenic pressures. Similarly, the literature reports high microplastic counts in some individuals, reflecting the heterogeneity of environmental exposure (Hidalgo-Ruz et al., 2012; Lusher et al., 2017; Jabeen et al., 2017; Atıcı et al., 2021)(Figure 3). In contrast, no significant relationship was found between other variables (weight, mouth width, mouth depth, gastrointestinal volume) and the number of MP/individual ($p > 0.05$, Table 3). This situation can be interpreted as larger individuals having a higher probability of ingesting microplastics due to longer feeding times, increased food intake, and greater contact with larger water volumes. The literature suggests that microplastic ingestion is related to species' ecological niches and feeding strategies (Setala et al., 2014; McNeish et al., 2018). The lack of a significant association with body weight and oral morphology suggests that microplastic ingestion is related to environmental concentrations and exposure time rather than morphometric constraints.

Table 3. Results of Spearman correlation analysis between morphometric and total microplastic count variables.

Variables	Spearman's ρ	p-value (2-tailed)	95% CI Lower	95% CI Upper
Weight	0.176	0.353	-0.208	0.512
Total length	0.428*	0,018*	0.069	0.689
Mouth width	-0.025	0.896	-0.391	0.348
Mouth depth	0.08	0.675	-0.299	0.437
Total stomach volume	-0.04	0.835	-0.404	0.335

*Significant at $p < 0.05$

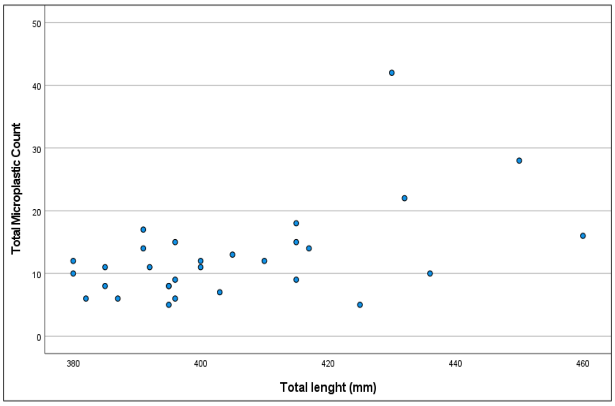

Figure 3. Relationship between total length (mm) and microplastic number.

Demersal and bentopelagic feeding species are at greater risk because they consume sediment layers with high microplastic accumulation along with their food (Wright et al., 2013). In this context, our study suggests that the high MP density in carp exhibiting benthic-omnivorous characteristics in Almus Dam Lake may also play a significant role in sediment-derived exposure. Indeed, Gedik and Atasaral (2022) detected MP in the sediment of the same lake at a concentration of 31 MP/kg. When compared in terms of sediment density, the average reported MP in Xiangshan Bay is 74 MP/kg (Wu et al., 2019), and values ranging from 760-1440 units per m^2 have been reported in Sürgü Dam Lake (Turhan, 2022). However, the lack of a linear relationship between sediment and microplastic accumulation in fish tissues indicates that bioaccumulation depends not only on environmental density but also on the species' feeding behavior, habitat use, and trophic position.

Based on the analysis of the shape and color distribution of microplastics, the dominant microplastic type was determined to be fiber (72.11%) (Figure 4). Particle-type microplastics constituted 27.89% of the total. The frequent occurrence of microplastics in fiber form is associated with textile wastewater, synthetic yarn, fishing, aquaculture equipment, or domestic waste sources (Browne et al., 2011; Lusher et al., 2016; Gedik and Atasaral, 2022).

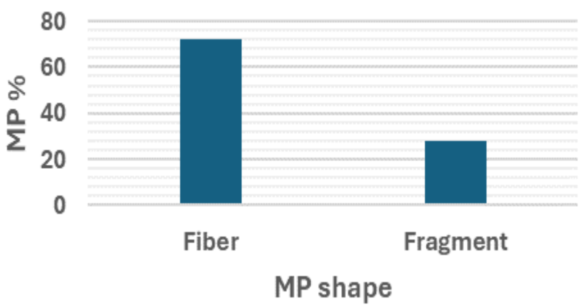

Figure 4. Distribution of shape and color of microplastics (%)

When the color distribution of microplastics was examined, black microplastics were the most common (47.11%), followed by blue (25%) and red (17.37%). Transparent (4.21%), purple (3.42%), and green (2.11%) microplastics were detected in lower proportions (Figure 5). Considering the intensive trout farming in the study area, it is suggested that the black and blue microplastic particles detected in carp may be a result of these farming activities. Cage nets, lashing ropes, plastic feed bags, and other synthetic equipment can wear down over time and break down into microplastics in the form of fibers and particles. This seems consistent with the predominance of dark-colored fibers and particles. The predominance of the fiber form, in particular, supports both direct uptake from the water column and ingestion of secondary microplastics accumulated in the sediment during benthic feeding (Wright et al., 2013).

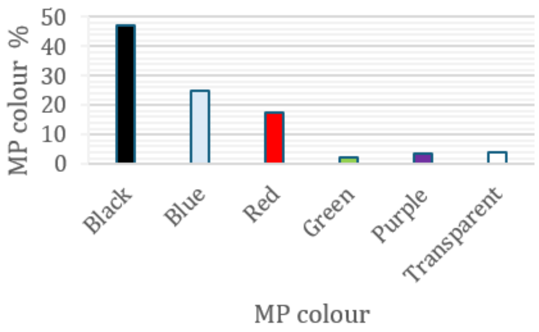

Figure 5. Color distribution (%) of microplastics.

When the size distribution percentages of microplastics given in Figure 5 are examined, particles in the <1 mm size group are divided into subgroups of <0.3 mm (16.84%), 0.3–0.5 mm (8.16%), and 0.5–1 mm (13.16%), totaling 38.16%. Particles in the 1–2.5 mm size range were detected at a rate of 19.74%, and particles in the 2.5–5 mm size range at a rate of 20.78%.

Particles in the larger size range of 5–25 mm (20.53%) and >25 mm (0.78%) were excluded from the definition of microplastics and were evaluated as mesoplastics and macroplastics (Figure 6).

In general, since microplastics are classified by size, with dimensions smaller than 5 mm, the vast majority of plastics identified in this study (78.68%) were classified as microplastics (Figure 6). This indicates that large quantities of secondary microplastic particles in the environment undergo physical degradationThe polymer types identified in the studies provide complementary data for understanding the prevalence and sources of microplastic pollution. Due to equipment limitations in this study, analysis of polymer types (FTIR or Raman spectroscopy) could not be performed, and this is considered a methodological limitation of the study.

Studies conducted in inland waters and coastal ecosystems in Türkiye consistently show that the most common polymer types are polyethylene (PE), polypropylene (PP), and polyethylene terephthalate (PET) (Atıcı et al., 2021; Erdoğan, 2025; Güngor et al., 2025). For example, at Sürgu Lake, the main polymers were PET (29.1%) and PP (19.4%) (Turhan, 2022). Similarly, in Çernek Lake, the dominant polymers were PET (44.58%) and PP (34.94%) (Terzi et al., 2025). In fish samples collected from Lake Van, the polymers were reported to consist of PE and PP (Atıcı et al., 2021).

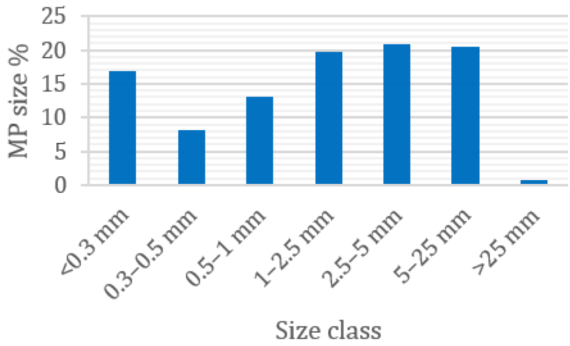

Figure 6. Size distribution (%) of microplastics.

Previous studies conducted in Almus Dam Lake determined that microplastics in sediment and mussels were 100% fibrous. Furthermore, the polymer distribution was 50% PET and 50% PP (Gedik and Atasaral, 2022). The presence of PET-dominant fibers in the sediment is explained by the direct or surface runoff of domestic wastewater from settlements around Almus into the lake. Similarly, synthetic nets and ropes used for fishing and aquaculture in the lake are a significant source of PP-based fibers. The prevalence of these polymer types is directly related to their widespread use in daily life. PE and PP are commonly used in packaging materials, food containers, fishing equipment, and personal care products (Atıcı et al., 2021; Güngör, 2025). On the other hand, PET is considered a specific pollution indicator originating from beverage bottles and textile fibers (Turhan, 2022; Yünlü et al., 2025).

In this study, the predominance of fiber and dark-colored particulate matter in the digestive system of carp is consistent with this homogeneous pollution structure originating from sediment. Therefore, it shows that microplastics enter the bioavailability not only from the water column but also from the benthic environment within the trophic system. This finding supports the idea that microplastic pollution in Almus Dam Lake is primarily caused by household textile fibers and fishing equipment.

This study has some limitations. The limited number of individuals from whom samples were taken and the fact that the samples were collected over a limited time may limit the generalizability of the results. Although the contamination of the control samples is considered negligible, the possibility of microplastics, especially in fibrous form, entering the environment via atmospheric transport cannot be completely ruled out. Furthermore, the failure to account for seasonal effects in this study, given that microplastic concentrations can vary seasonally, is a significant limitation. Moreover, the polymer types of microplastics could not be directly confirmed due to the inability to use spectroscopic analytical methods such as FTIR spectroscopy.

4. Conclusion

This study investigated the presence and characteristics of microplastics in the digestive systems of carp living in Almus Dam Lake. The detection of microplastics in all samples (100%) indicates that microplastic pollution is a widespread and persistent problem in the study area. The amount of microplastics per fish ranged from 5 to 42 MP/fish, with an average of 12.66 ± 7.55 MP/fish. This value is higher than that reported in many studies of similar ecosystems and indicates a significant pollution impact in the region. Simultaneous assessment of the shape, color, and size of microplastics in carp clearly reveals that the pollution detected in Almus Lake Dam is largely secondary microplastics. The predominance of fibrous forms (72.11%) and black, blue, and red-colored particles suggests that human-induced activities, such as the textile industry and aquaculture, may play a significant role. The classification of the vast majority of particles (<5 mm) as microplastics indicates active degradation processes in the environment, while the presence of mesoplastic and macroplastic particles indicates ongoing plastic input into the system.

Spearman's correlation analysis revealed a significant positive correlation between microplastic count and total body length, whereas no significant correlation was found with other morphometric variables, such as weight and oral morphology. This finding suggests that microplastic intake may be related to factors such as size, feeding behavior, and exposure duration, rather than individual morphological characteristics.

These results demonstrate that both sediment and water-column impacts are evident in the study area, and that benthic omnivore species are significantly affected. Therefore, management strategies aimed at reducing microplastic pollution should consider not only surface litter control but also the management of aquaculture equipment and the monitoring of sediment quality. Nevertheless, this study is one of the first microplastic studies conducted on fish in Almus Dam Lake, and it contributes to the development of monitoring, risk assessment, and management strategies by providing fundamental data on microplastic pollution in the region.

Future studies that comprehensively evaluate sediment, biota, and water-column samples; verify polymer types using spectroscopic methods; reveal seasonal and spatial variations; and elucidate possible trophic transfer mechanisms will contribute to a more comprehensive, mechanism-based understanding of pollution levels in the region.

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Authorship contribution statement

M.H.: Writing – review & editing, Methodology, Visualization, Data curation, Funding acquisition, Conceptualization, Investigation

A.Ö.: Writing – original draft, Visualization, Methodology, Formal analysis, , Data curation, Investigation

Conflict of interest

The authors declare no conflicts of interest.

Ethical Statement

Since commercially sourced fish material was used in the study, ethical committee approval is not required.

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