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HUMAN DIMENSIONS OF MARINE LITTER: PUBLIC AWARENESS IN THE URBANIZED AREA OF ÇANAKKALE STRAIT

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Abstract

Marine litter has become one of the major environmental pressures affecting coastal and marine ecosystems worldwide, largely driven by human activities and consumption patterns. Understanding the human dimension of marine environmental problems is therefore essential for effective marine ecosystem protection and management. This study aims to assess public awareness, perceptions, and attitudes toward wastes and marine litter in the urbanized area of the coastal region of Çanakkale Strait (Türkiye), with a focus on human–marine environment interactions. Data were collected through a questionnaire-based survey conducted with local residents living in Çanakkale, the most urbanized coastline at the western outreach of the Strait towards the Aegean Sea.The survey examined participants' awareness of marine litter sources, perceived environmental impacts, preferred mitigation measures, and willingness to participate in coastal clean-up activities. Descriptive statistical methods were used to evaluate general awareness levels and public perceptions related to marine litter. The findings indicate that respondents largely recognize plastic as the most prominent component of marine litter and demonstrate a generally positive attitude toward participation in mitigation activities. However, limited prior exposure to marine litter-related information and the predominance of individual-based solutions, such as "warning people" suggest gaps in deeper structural awareness and policy-level understanding. Given the strategic role of the Çanakkale Strait as a marine corridor connecting multiple seas, local human behavior may have implications beyond the study area. The study provides baseline information on public awareness in an urbanized strait setting and offers insights to support coastal management practices, environmental education programs, and participatory marine litter monitoring initiatives.

Keywords: Çanakkale Strait, coastal environment, marine litter, public awareness, questionnaire survey

Introduction

Marine pollution is a growing global environmental problem caused by the direct or indirect introduction of substances into the marine environment, resulting in harmful effects on human health, marine organisms, and ecosystem quality. Among the various forms of marine pollution, marine litter has emerged as one of the most visible and persistent threats to marine and coastal environments. Marine litter is defined as any persistent, manufactured, or processed solid material that is abandoned, discarded, or lost in the marine or coastal environment (UNEP, 2005; Corcoran et al., 2009; Galgani et al., 2013). Sources of marine litter are generally classified as land-based and sea-based. Land-based sources include waste transported to marine environments via rivers, wind, storm water runoff, and inadequate waste management practices, while sea-based sources originate from maritime activities such as shipping, fishing, and offshore operations (Öko-Institut e.V., 2012; Veiga et al., 2016; Beaumont et al., 2019). Due to increasing coastal populations and human activities, land-based sources are considered the dominant contributors to marine litter worldwide. Marine litter poses significant risks to marine ecosystems and human well-being. Its impacts include entanglement and ingestion by marine organisms, habitat degradation, and the introduction of toxic substances into food webs (Laist, 1997; Wang et al., 2019; Brentano and Petry, 2020). Consequently, reducing marine litter has become a priority for the protection of marine environments and the sustainable use of coastal resources. Monitoring and assessment studies play a crucial role in understanding the distribution, composition, and sources of marine litter. Beach litter surveys, in particular, provide valuable information for evaluating the effectiveness of existing policies and mitigation measures (OSPAR, 2010). Over recent decades, research on marine litter has increased substantially at both global and regional scales (Carpenter &Smith, 1972; Derraik, 2002; Galgani et al., 2013; Galgani et al., 2023; Hong et al., 2014; Mokos et al., 2020; Rangel-Buitrago et al., 2020; Veerasingam et al., 2020; Takaya et al., 2022; Gómez et al., 2023; Marin et al., 2024; Bekova & Prodanov, 2024; Edward et al, 2025).

In Türkiye, numerous studies have investigated marine litter along the coasts of the Black Sea, Mediterranean Sea, Aegean Sea, Marmara Sea, and the Dardanelles Strait (Topçu et al., 2013; Terzi & Seyhan, 2014, 2017; Aydın et al., 2016; Yenici, 2019; Artüz, 2021; Ertaş et al., 2022; Yenici & Türkoğlu, 2022; Yenici et al., 2022; Yenici, 2026). These studies consistently report plastic as the most abundant and persistent material in marine litter. Recent monitoring studies conducted in Türkiye and neighboring coastal regions continue to confirm the predominance of plastics in marine litter composition (Bekova & Prodanov, 2024; Terzi et al., 2025; Altinpinar, 2025). However, despite the growing body of research on the composition, abundance, and sources of marine litter, studies focusing on public awareness, perceptions, and behavioral dimensions remain relatively limited, particularly at the local scale in urbanized coastal regions. Public behavior and awareness play a critical role in the generation and reduction of marine litter. Understanding citizens' knowledge, attitudes, and willingness to participate in mitigation activities is therefore essential for designing effective awareness-raising programs and policy interventions. In addition to its local importance, the Çanakkale Strait represents a critical marine corridor connecting the Black Sea, the Sea of Marmara, the Aegean Sea, and the Mediterranean Sea. Surface currents originating from the Black Sea flow southward through the strait, transporting water masses, nutrients, and pollutants toward the Aegean and Mediterranean Seas (Ünlüata et al., 1990; Özsoy & Ünlüata, 1997). Recent oceanographic research using numerical modelling has further characterized the water exchange dynamics in the Dardanelles, highlighting the variability of mass exchange between the Black Sea and the Marmara Sea and its implications for regional hydrodynamics (Saçu et al., 2024).

Consequently, marine litter generated or inadequately managed in coastal settlements along the strait may have implications beyond the local scale, potentially influencing wider marine ecosystems within interconnected basins. Therefore, understanding public awareness and attitudes toward marine litter in this region is relevant not only for local coastal management but also for broader regional and transboundary marine pollution mitigation efforts.

In this context, the present study aims to assess the awareness, knowledge, and attitudes of citizens in Çanakkale regarding marine litter through a questionnaire-based survey. By evaluating public perceptions and levels of engagement, the study seeks to provide preliminary insights that may support future awareness initiatives and contribute to the development of more effective local and national marine litter management strategies. Understanding public awareness at the local scale is essential for developing targeted education, communication, and coastal management approaches. Even small-scale and exploratory studies can offer valuable insights into human behavior and perceptions, supporting integrated marine management efforts and complementing ecological and biological research on marine pollution.

Material and Method

This study was conducted in Çanakkale, a coastal city located in northwestern Türkiye, during December 2022. Data were collected through face-to-face questionnaire surveys conducted with members of the general public, living in Çanakkale, the most urbanized coastline at the western outreach of the Çanakkale Strait towards the Aegean Sea, composing the northern part of the Mediterranean. Prior to participation, respondents were informed about the purpose of the study, in order to ensure voluntary participation. A simple random sampling method, one of the probability sampling techniques, was employed to select participants (Yıldız, 2017; Arıkan, 2018). A total of 50 individuals participated in the survey. Although the sample size is limited, it was considered sufficient for an exploratory assessment of public awareness and perceptions regarding marine litter at the local scale.

The questionnaire consisted of 15 questions divided into two main sections. The first section included demographic questions related to gender, age, education level, and occupation. The second section focused on participants' awareness and perceptions of marine litter, including perceived types of marine litter, awareness of marine litter-related activities and information, perceived solutions for reducing marine litter, and willingness to participate in coastal clean-up activities. Survey data were analyzed using descriptive statistical methods. Frequencies (f) and percentages (%) were calculated to summarize participant responses. Due to the limited sample size and the exploratory nature of the study, no inferential statistical analyses were conducted.

Results

The demographic characteristics of the participants are summarized (Table 1). Of the 50 respondents, 20 (40%) were female and 30 (60%) were male. Half of the participants (n = 25; 50%) were between the ages of 39 and 59. A total of 26 participants (52%) held an undergraduate degree or higher, and 35 participants (70%) were employed.

When asked about the type of material most commonly associated with marine litter, the majority of participants identified plastic (96%), followed by metal (2%) and glass (2%). Regarding perceived solutions for reducing marine litter, 50% of respondents indicated warning people as the most effective approach, 32% emphasized education, and 18% stated that none of the proposed options would be effective.

Table 1. Demographic characteristics of the participants (n = 50).

		f	%
Gender	Female	20	40
	Male	30	60
Age	<19	5	10
	19-28 age range	3	6
	29-38 age range	10	20
	39-59 age range	25	50
	>59	7	14
Education	Primary School	6	12
	Middle School	7	14
	High School	11	22
	Degree	21	42
	Master Degree	4	8
	Doctorate	1	2
Occupation	Officer	25	50
	Private Sector	10	20
	Student	5	10
	Not Working	10	20

Participants were also asked about their willingness to participate in marine litter collection activities. Overall, 76% of respondents (38 out of 50) stated that they would be willing to participate in such activities if organized along the coast. In addition, 56% of participants expressed an interest in receiving more information about marine litter. The distribution of willingness to participate in marine litter collection activities at the seaside according to age is given (Figure 1).

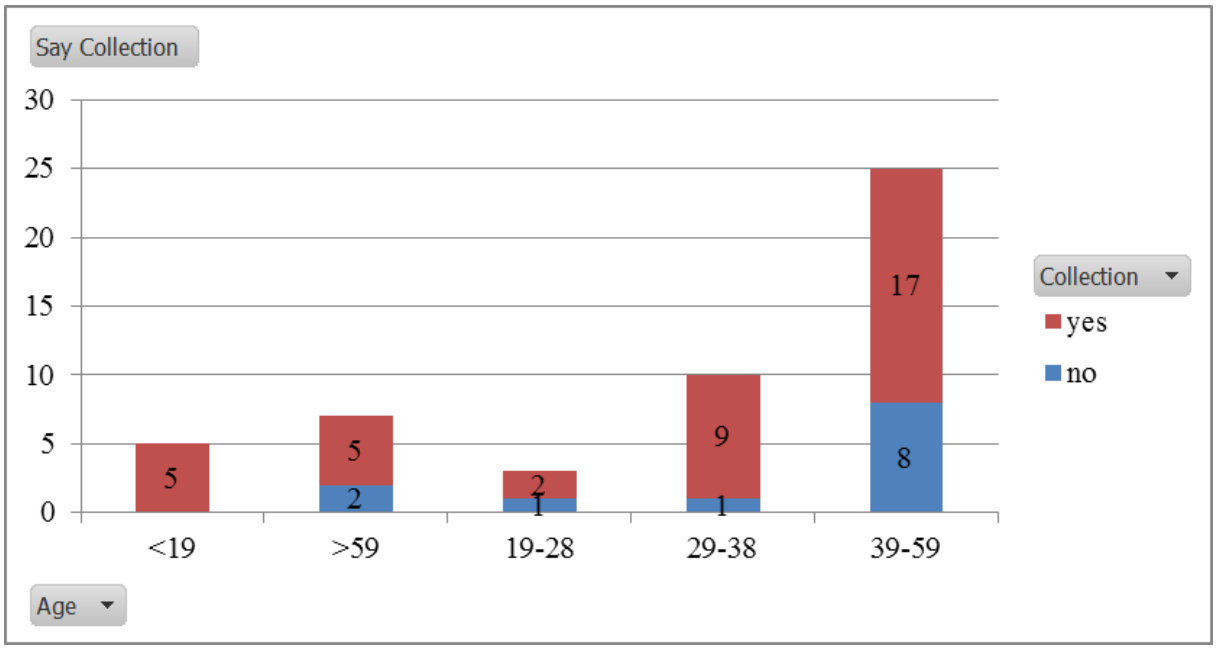

Figure 1. Distribution of respondents' willingness to participate in coastal marine litter collection activities across age groups.

With respect to awareness of marine litter-related information and activities, 46% of participants reported that they had not encountered any information, activities, or initiatives related to marine litter prior to the survey. This finding indicates a notable lack of exposure to awareness-raising efforts among a substantial proportion of respondents.

Willingness to participate in marine litter collection activities varied across age groups (Figure 1). All participants under the age of 19, 100% (5out of 5) reported that they would participate in marine litter collection activities. Among participants aged 19–28, 66.7% (2 out of 3) indicated willingness to participate, while 33.3% (1 out of 3) did not. In the 29-38 age group, 90% (9 out of 10) expressed willingness to participate, compared to 10% (1 out of 10) who did not. In the 39–59 age group, 68% (17 out of 25) reported willingness to participate, whereas 32% (8 out of 25) stated that they would not. Among participants aged over 59, 71.4% (5 out 7) reported willingness to participate, whereas 28.6% (2 out of 7) indicated unwillingness. Awareness of marine litter through social media across age group is presented (Figure 2).

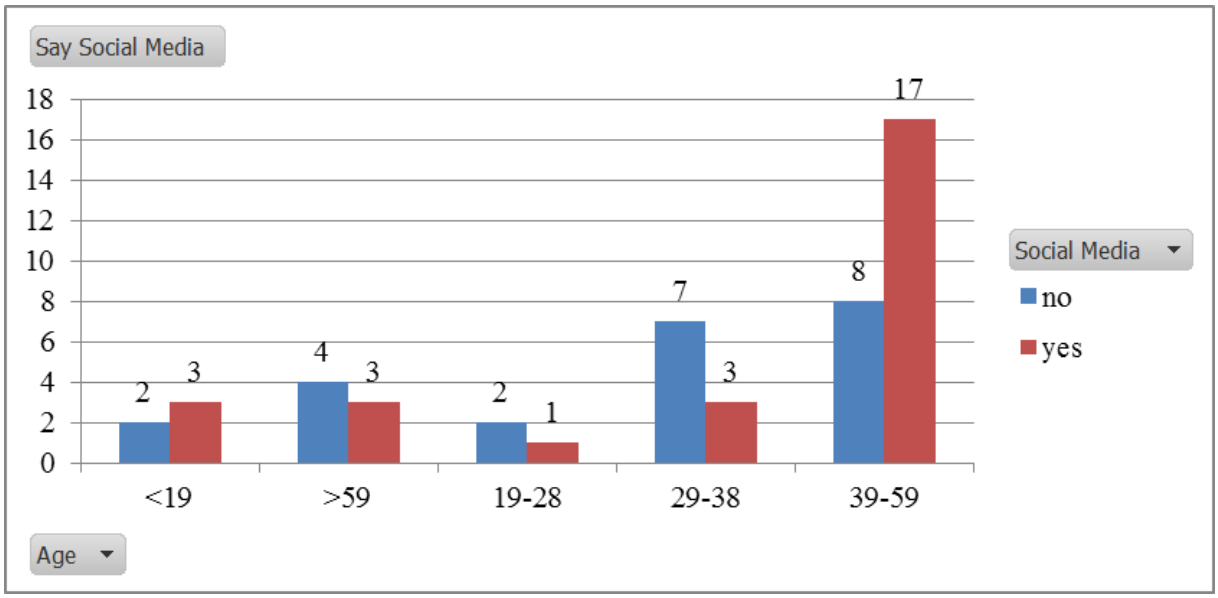

Figure 2. Awareness of marine litter through social media across age groups.

Figure 2 illustrates the distribution of participants who reported awareness of marine litter via social media across age groups. Awareness was highest among participants aged 39–59 (17 out of 25), both in absolute number and proportion. Lower levels of social media awareness were observed in the 29-38 age group (3 out of 10) and in participants aged over 59 (3 out of 7).

A comparison of perceived effective solutions for marine litter reduction across education levels is presented (Figure 3). Across all education groups, “warning people” was most frequently identified as the most effective measure for reducing marine litter.

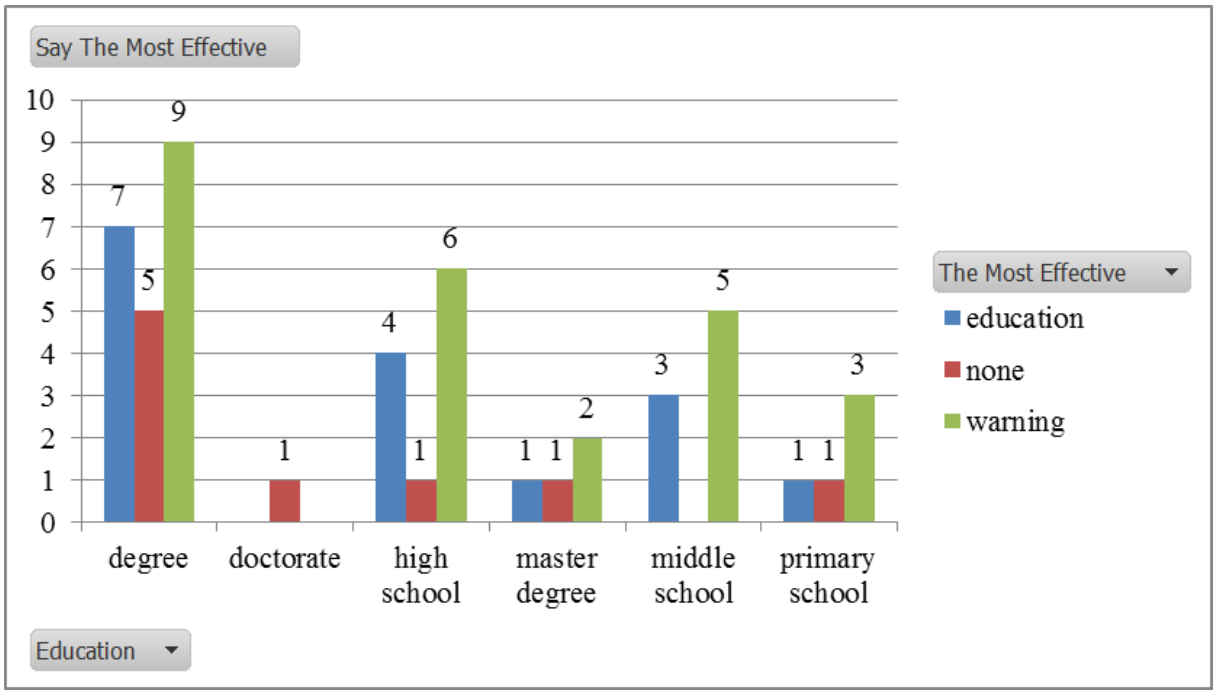

Figure 3. Perceived most effective solution for marine litter reduction by education level.

Discussion

This study provides an exploratory assessment of public awareness, perceptions, and attitudes toward marine litter in the urbanized coastal area of the Çanakkale Strait. The findings reveal that while respondents largely recognize marine litter as an environmental problem—particularly plastic waste—there remain important gaps in exposure to information and structured awareness initiatives. These results highlight both the presence of environmental concern and the limitations of current communication and management strategies at the local scale.

One of the most striking findings of this study is the strong association of marine litter with plastic materials (96%). Field-based monitoring studies conducted along the Çanakkale Strait and Bozcaada coasts similarly identified plastics as the dominant material type in terms of density and weight (Yenici, 2026; Yenici & Türkoğlu, 2022; Yenici et al., 2022). Comparable patterns have also been documented across different coastal regions of Türkiye, where plastics consistently constitute the largest proportion of marine litter (Topçu et al., 2013; Terzi & Seyhan, 2014; Aydın et al., 2016; Ertaş et al., 2022; Terzi et al., 2025; Altinpinar, 2025). These findings align with broader international research demonstrating that plastics dominate marine litter composition in coastal environments worldwide (Galgani et al., 2013; Smith & Markic, 2013; Rangel-Buitrago et al., 2020; Veerasingam et al., 2020; Takaya et al., 2022; Bekova & Prodanov, 2024; Marin et al., 2024; Edward et al., 2025). The convergence between environmental monitoring data and public perception observed in the present study suggests that visible plastic accumulation along the coastline may directly influence community awareness and risk perception. Recent European monitoring assessments further confirm the overwhelming prevalence of plastics in marine litter composition (Šubelj & Veiga, 2024).

The high recognition of plastic as the most harmful type of marine litter by participants further supports this pattern, as similar coastal perception studies have shown widespread awareness of the environmental impacts of marine litter (Herrera et al., 2023). Awareness and engagement strategies, particularly social media campaigns, have also been linked to increased public

involvement and pro-environmental behavioral intentions regarding marine litter issues (Emirzade & Huseyinoglu, 2025). The high level of plastic awareness observed in this study should be interpreted not merely as consistency with previous findings, but as the outcome of multiple reinforcing mechanisms. First, plastics are physically persistent and visually dominant in coastal environments, increasing their cognitive salience compared to less visible forms of marine pollution such as chemical contamination or eutrophication. Risk perception research suggests that hazards which are more visible and emotionally evocative tend to be perceived as more severe and urgent (Slovic, 1987). In coastal settings, frequent visual exposure to plastic debris may therefore directly shape community-level risk awareness. Second, media amplification may further reinforce this perception by framing plastic pollution as a global environmental crisis through the widespread circulation of emotionally powerful imagery. Third, social media platforms increasingly function as normative arenas where pro-environmental attitudes are reinforced and shared, particularly among younger populations (Emirzade & Huseyinoglu, 2025). Taken together, these dynamics suggest that plastic awareness in Çanakkale likely arises from the interaction of visual exposure, media framing, and digitally mediated social norms. However, this selective awareness may not necessarily reflect comprehensive environmental literacy regarding the structural drivers of marine litter production and waste governance systems. In the specific context of the Çanakkale Strait, the hydrodynamic structure of this narrow and highly dynamic waterway, combined with intense maritime traffic and seasonal tourism, may contribute to the localized accumulation of floating and stranded plastic debris along certain coastal segments. Such visible concentration effects can reinforce public awareness through repeated direct exposure in everyday life. In this sense, plastic pollution in Çanakkale may not only be a globally mediated issue shaped by media and digital discourse, but also a locally observable environmental reality that strengthens risk perception at the community level.

Despite this positive inclination toward participation, 46% of respondents reported that they had not previously encountered any information, activities, or initiatives related to marine litter. This finding indicates a significant awareness gap. Limited exposure to environmental communication campaigns may reduce the effectiveness of existing policies and hinder the development of informed environmental behavior. Studies on environmental communication emphasize that repeated exposure to information through multiple channels—such as social media, educational programs, and community initiatives—is essential for strengthening environmental literacy and encouraging behavioral change. The results therefore suggest that awareness-raising activities in Çanakkale may not yet be sufficiently visible or accessible to the broader public.

The high willingness to participate in coastal clean-up activities (76%) further supports the existence of pro-environmental behavioral intentions among the local population. However, environmental psychology literature frequently highlights the so-called “attitude–behavior gap,” where positive environmental attitudes do not always translate into sustained action (Galgani et al., 2013). In this study, willingness should therefore be interpreted as a potential resource for participatory coastal management rather than as evidence of ongoing engagement. Structured and continuous initiatives are necessary to transform intention into consistent environmental stewardship. Moreover, observed differences between age groups may partially reflect sample composition rather than actual behavioral differences. Given the relatively small sample size and the uneven distribution across age categories, the apparent variation in willingness or awareness between groups should be interpreted with caution. The study relies primarily on descriptive statistics and does not employ inferential tests to determine statistical significance. Therefore, observed age-related differences may indicate exploratory tendencies

rather than robust generational patterns. Future research with larger and more balanced samples is necessary to verify whether these differences reflect genuine behavioral variation or sampling effects.

An additional noteworthy finding is that "warning people" was more frequently perceived as the most effective solution compared to formal education. This may indicate a tendency to frame marine litter primarily as an issue of individual responsibility, reflecting a perception that the problem is mainly driven by personal behavior rather than structural and institutional factors related to waste governance and production systems. Previous studies emphasize that effective marine litter mitigation requires multi-level approaches combining behavioral change, regulatory enforcement, improved waste infrastructure, and circular economy strategies (Veiga et al., 2016). The predominance of individual-level solutions in participant responses suggests that public understanding of marine litter governance may remain relatively narrow. Strengthening environmental literacy could therefore broaden the perception of responsibility beyond individual misconduct toward shared institutional and structural accountability. This predominance of "warning people" as a preferred solution may reflect a culturally embedded tendency to conceptualize environmental problems primarily through individual moral responsibility rather than structural governance mechanisms. In contexts where environmental communication is largely based on signage, public warnings, and rule enforcement, behavioral change may be perceived as a matter of compliance rather than systemic transformation. The relative invisibility of waste management infrastructures, regulatory frameworks, and producer responsibility schemes in everyday public discourse may further reinforce this perception. Consequently, participants may gravitate toward solutions that are cognitively accessible and socially familiar, even if such approaches address only the symptomatic rather than structural dimensions of marine litter. This pattern underscores the need to expand public understanding from individual misconduct toward shared institutional accountability within marine litter governance.

At the European level, participatory marine litter monitoring has become increasingly institutionalized through citizen science frameworks. For example, initiatives coordinated by the European Environment Agency, particularly the Marine LitterWatch platform, enable volunteers to systematically record beach litter data while simultaneously contributing to environmental monitoring and public awareness. Such structured systems integrate scientific data generation with civic engagement, reinforcing environmental literacy and strengthening governance capacity. Compared to these institutionalized volunteer-based systems in Europe, Türkiye currently lacks a widely implemented and standardized citizen-based marine litter monitoring mechanism integrated into national reporting frameworks. It should be noted that Türkiye participates in the international Blue Flag programme, which includes environmental education and beach monitoring criteria aimed at improving coastal environmental quality. However, while the Blue Flag framework promotes awareness and compliance with environmental standards, it does not function as a standardized, publicly accessible citizen-based marine litter data generation system comparable to the EEA's Marine LitterWatch platform. Therefore, although awareness-oriented coastal initiatives exist, the integration of volunteer-based litter monitoring into national environmental reporting and governance structures remains limited. Although local clean-up campaigns and awareness activities are periodically organized, systematic volunteer-driven data collection remains limited. The high willingness to participate in coastal clean-up activities identified in the present study (76%) indicates a latent participatory potential within the local population. Therefore, this study may serve as a preparatory social baseline for the development of structured citizen science initiatives in strategically important marine corridors such as the Çanakkale Strait. By

identifying awareness levels, perception patterns, and motivational tendencies, the research contributes to the foundational knowledge necessary for integrating community-based monitoring approaches into national marine litter governance systems. Strengthening such participatory mechanisms could enhance Türkiye's alignment with European monitoring practices while simultaneously fostering long-term environmental stewardship at the local scale.

Marine pollution encompasses a broader range of stressors, including chemical contamination, pathogenic inputs, thermal pollution, and underwater noise. Recent studies conducted in the Çanakkale Strait have highlighted additional pressures such as underwater noise pollution and its potential ecological impacts (Kuşku et al., 2023). While these dimensions represent critical environmental concerns, the present research intentionally focuses on socially perceptible, solid marine litter as a distinct component of marine pollution. This clarification refines the scope of the study and addresses potential conceptual ambiguity. Importantly, this study advances the literature by integrating ecological monitoring findings with social perception data within the same geographically strategic marine corridor. Previous research in the Çanakkale Strait has extensively documented the composition and abundance of marine litter, particularly plastics (Yenici, 2026; Yenici & Türkoğlu, 2022; Yenici et al., 2022). However, limited research has examined how local communities perceive these environmental pressures. By linking environmental measurements with public awareness patterns, the present study provides a complementary social dimension to existing marine litter research in Türkiye. This integrative perspective is particularly relevant in transitional marine systems such as the Çanakkale Strait, where local inputs may have broader regional implications due to hydrodynamic connectivity. Given the hydrodynamic connectivity between the Aegean Sea and the Sea of Marmara, marine litter generated or mismanaged along the Çanakkale Strait has the potential to be transported beyond local coastal boundaries. In this sense, individual behaviors and local waste management practices may indirectly influence pollution dynamics at a broader regional scale. Understanding public awareness and behavioral tendencies in such a marine corridor is therefore not only locally relevant but also critical for regional marine governance. The present study contributes to the literature by linking social perception patterns to the ecological vulnerability of a strategically interconnected marine system.

Overall, the findings suggest that baseline awareness and environmental concern are present among survey participants in the Çanakkale Strait region, while structured awareness mechanisms and governance-oriented understanding remain limited. Enhancing public education, participatory initiatives, and policy communication strategies in such strategically important marine corridors may contribute not only to local coastal protection but also to regional marine litter mitigation efforts across interconnected basins. By situating public awareness within the hydrodynamically interconnected system of the Çanakkale Strait, this research highlights the importance of integrating social indicators into marine litter governance frameworks. Future research should employ larger and more diverse samples, apply inferential statistical analyses, and explore behavioral determinants in greater depth to better understand the drivers of environmental engagement. Strengthening the social component of marine litter research may ultimately enhance the effectiveness of regional marine management strategies and support more holistic approaches to marine environmental protection.

The findings of this study are subject to some limitations. The relatively small sample size and the use of descriptive statistics limit the generalizability of the results beyond the study area. Furthermore, reliance on self-report data may lead to response bias. Despite these limitations, the study provides useful preliminary information on public awareness and attitudes towards

marine pollution in Çanakkale, offering important insights for future studies in urbanized areas along similar coastal waterways.

Conclusion

Marine pollution, particularly marine litter, remains a pressing environmental challenge that requires coordinated and sustained action. The results of this study indicate that while public awareness of marine litter exists to some extent, there is a clear need for more comprehensive and continuous awareness-raising initiatives at the local level. Given the limited sample size and the descriptive scope of the analysis, the findings should be regarded as preliminary. Nevertheless, they underscore the importance of strengthening public education, expanding information dissemination through multiple communication channels, and encouraging voluntary participation in marine litter reduction activities. Future studies should consider larger sample sizes, different geographic locations, and the application of inferential statistical methods to allow for more robust conclusions. Despite these limitations, this study contributes to the growing body of literature on marine litter awareness and provides a foundation for future research and policy-oriented initiatives. Considering the strategic location of the Çanakkale Strait as a marine corridor connecting multiple seas, the findings of this study have implications beyond the local scale. Strengthening public awareness and participation in such transition zones may contribute to the prevention of marine litter transport between interconnected marine basins. Future studies addressing similar coastal settings could support the development of more integrated and transboundary marine litter management strategies.

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Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Social and Human Sciences Ethics Committee of Bartın University (Protocol No: 2022-SBB-0517, approval date: 23 November 2022).

Informed consent

Not available as single author is present in this study.

Data availability statement

The author declares that data can be provided by corresponding author upon reasonable request.

Conflicts of interest

There is no conflict of interests for publishing this study.

Funding organizations

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Contribution of authors

Elif YENİCİ: Designing of the study, data analysis, writing original draft preparation.

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