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RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

Assessment of bathing water quality in the Sea of Marmara (2022-2024) and recommendations

Marmara Denizi'nde yüzme suyu kalitesinin değerlendirilmesi (2022-2024) ve öneriler

Sibel Zeki

Department of Marine Environment, Institute of Marine Sciences and Management, İstanbul University, İstanbul, Türkiye

Corresponding author: szeki@istanbul.edu.tr

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Abstract: The Sea of Marmara, a semi-enclosed inland sea in Türkiye, has a naturally sensitive ecosystem increasingly impacted by anthropogenic pressures. This study evaluated the bathing water quality along the Sea of Marmara, including the Straits of İstanbul and Çanakkale, and provided recommendations for enhancing the dissemination of monitoring results. Bathing water quality data from 176 sites, monitored by the Turkish Ministry of Health, were analyzed over three consecutive bathing seasons (2022-2024). The results indicate that in 2024, 66% of the monitored beaches were classified as excellent, a proportion lower than the European Union average. Furthermore, only 24% of those beaches received the Blue Flag certification. Spatial analysis revealed distinct provincial disparities, with Balıkesir and Çanakkale exhibiting the highest bathing water quality, whereas Yalova and Bursa recorded the poorest conditions, with roughly a quarter of their bathing waters classified as poor quality. These findings underscore the need for targeted interventions to improve bathing water quality, particularly in provinces with lower classifications, and to align Türkiye's bathing water standards more closely with EU benchmarks. In addition, the study emphasizes the importance of improving public access to monitoring results. Developing comprehensive national and regional reports, including data on beach closures, is recommended to enhance public awareness and policymaking. Such implementations are crucial for not only protecting public health but also facilitating targeted interventions, promoting sustainable beach management, and fostering tourism development.

Keywords: Bathing water quality, Blue Flag, fecal indicator bacteria, Sea of Marmara

Öz: Türkiye'de yarı kapalı bir iç deniz olan Marmara Denizi, antropojenik baskılardan giderek daha fazla etkilenen doğal olarak hassas bir ekosisteme sahiptir. Bu çalışma, İstanbul ve Çanakkale Boğazlarını da kapsayacak şekilde Marmara Denizi'nde yüzme suyu kalitesini değerlendirmiş ve izleme sonuçlarının yaygınlaştırılması için öneriler sunmuştur. Türkiye Sağlık Bakanlığı tarafından izlenen 176 yüzme alanının verileri, birbirini takip eden üç yüzme sezonu (2022-2024) boyunca analiz edilmiştir. Sonuçlarımız, izlenen plajların %66'sının 2024 yılında yüzme suyu kalitesi açısından mükemmel olarak sınıflandırıldığını ve bu oranın Avrupa Birliği ortalamasından daha düşük olduğunu göstermektedir. Ayrıca, bu plajların sadece %24'ü Mavi Bayrak sertifikası almıştır. Mekânsal analiz, iller arasında belirgin farklılıklar olduğunu ortaya koymuştur. Balıkesir ve Çanakkale en yüksek yüzme suyu kalitesini sergilerken, Yalova ve Bursa yüzme sularının yaklaşık dörtte birinin kötü kalite olarak sınıflandırılmasıyla en kötü koşulları kaydetmiştir. Bu bulgular, özellikle düşük sınıflandırmaya sahip illerde yüzme suyu kalitesini iyileştirmek ve Türkiye'nin yüzme suyu kalitesini AB ile daha uyumlu hale getirmek için hedefe yönelik müdahalelere duyulan ihtiyacı göstermektedir. Buna ek olarak, çalışmamız izleme sonuçlarının kamuoyuna daha iyi duyurulmasının önemini vurgulamaktadır. Politika yapıcıları ve kamuoyunu yüzme suyu kalitesi hakkında daha iyi bilgilendirmek için, plajların kapatılmasına ilişkin veriler de dahil olmak üzere, kapsamlı ulusal ve bölgesel raporların hazırlanması önerilmektedir. Bu tür uygulamalar sadece halk sağlığını korumak için değil, aynı zamanda hedefe yönelik müdahaleleri kolaylaştırmak, sürdürülebilir plaj yönetimini teşvik etmek ve turizm gelişimini desteklemek için de çok önemlidir.

Anahtar kelimeler: Yüzme suyu kalitesi, Mavi Bayrak, fekal indikatör bakteriler, Marmara Denizi

INTRODUCTION

Water sports such as swimming, diving, rowing, and fishing are popular recreational activities, especially during the summer months, in both marine and freshwater ecosystems. Ensuring the safe conduct of these activities requires maintaining high water quality standards. However, these aquatic environments are often contaminated with microorganisms that pose risks to human health (World Health Organization, 2021). Exposure to microbiologically contaminated waters is linked to an increased risk of gastrointestinal diseases, skin infections, and other pathogen-induced infections (Fewtrell and Kay, 2015; Leonard et al., 2018; Wade et al., 2022). Studies estimate that exposure to contaminated recreational waters causes 90 million illnesses annually in the United States, with an economic burden of approximately $2.9 billion (DeFlorio-Barker et al., 2017). Therefore, regular monitoring of recreational waters and maintaining safe microbial water quality are essential for protecting public health. Additionally, these measures support ecosystem sustainability and provide economic benefits for tourism and local communities (Devane et al., 2020; Holcomb and Stewart, 2020).

Microbial water quality assessment primarily relies on fecal indicator organisms (FIOs), including bacteria, viruses, or other microorganisms that signal potential fecal contamination. Elevated FIO levels indicate a higher risk of pathogenic microorganisms. Currently, *Escherichia coli* (*E. coli*) and intestinal enterococci are the most widely used indicators for microbial contamination in both freshwater and marine environments (Tiwari et al., 2021; World Health Organization,

2021). The classification of microbial water quality based on these indicators varies by national standards and regulations. In the European Union (EU), bathing waters are monitored and classified under the Bathing Water Directive (European Commission, 2006). Similarly, in the United States, the Environmental Protection Agency (EPA) enforces microbial water quality standards through the Recreational Water Quality Criteria (USEPA, 2012) to safeguard public health. In Türkiye, microbial water quality is regulated by the Regulation on the Management of Bathing Water Quality (RMBWQ) (2019), which aligns with the EU Bathing Water Directive. This regulation replaced total coliform and fecal coliform analysis with *E. coli* analysis, improving the precision of bathing water quality assessments. The Ministry of Health of Türkiye (MoH) conducts water quality monitoring and publishes results online via the Bathing Water Monitoring System (https://yuzme.saglik.gov.tr). Meanwhile, the Ministry of Environment, Urbanization and Climate Change of Türkiye (MoEUCC) is responsible for establishing bathing water profiles, which are available through the Bathing Area Information System (https://plaj.csb.gov.tr).

Another national regulation governing the microbial water quality classification is the Regulation on Surface Water Quality (2012), which defines the microbial standards for coastal and transitional waters used for recreational purposes. Additionally, the Blue Flag Program complements national regulations by promoting high bathing water quality standards in Türkiye. The Blue Flag is an international environmental award granted to beaches, marinas, and tourism boats that meet strict environmental criteria. Managed globally by the Foundation for Environmental Education (FEE) and represented in Türkiye by the Turkish Environmental Education Foundation (TÜRÇEV). The program has been implemented in Türkiye since 1993, leading to a steady increase in the number of qualifying beaches. The program consists of 33 criteria, covering environmental education, bathing water quality, environmental management, and safety. Among these, Criterion 10 mandates that microbiological parameters influencing bathing water quality remain within specified limits (TÜRÇEV, 2019). Together, these regulations and programs ensure that bathing waters in Türkiye remain safe for public health and environmentally sustainable.

Türkiye has a total coastline of 8,592 km along the Mediterranean, Aegean, Marmara, and Black Seas (excluding islands), providing numerous bathing water areas essential for tourism and recreation. The Sea of Marmara accounts for approximately 17% of this coastline, extending 1,474 km (Uzun and Celik, 2014). Over the past decade, the ecological condition of the Sea of Marmara has deteriorated significantly due to increasing human activities, pollution, and climate change. Inputs from domestic and industrial wastewater, riverine pollution, and agricultural runoff, have negatively impacted microbial water quality (Akoglu et al., 2024; Demirel et al., 2023; İşinibilir et al., 2024). Given the fragile nature of this ecosystem, monitoring of bathing waters is crucial for both public health and environmental sustainability. However, academic studies on the microbial water quality of the Sea of Marmara remain limited, focusing mainly on the Golden Horn (Çelik and Zeki, 2024; Karabas et al., 2018; Zeki et al., 2021), the southwest coast of İstanbul (Altuğ and Hulyar, 2020; Sönmez and Sivri, 2022), and the Prince's Islands (Karaman Baş and Altuğ, 2022). While nationwide bathing water quality monitoring is conducted annually during the bathing season, the collected data are not comprehensively evaluated, and country- and region-specific reports are either not prepared or not effectively communicated to the public. In this context, the objectives of this study were (1) to evaluate the bathing water quality in the Sea of Marmara from 2022 to 2024 and (2) to provide recommendations for enhancing the transparency and effectiveness of bathing water quality monitoring in Türkiye.

MATERIALS AND METHODS

Study area

This study focuses on the Sea of Marmara, the Strait of İstanbul, and the Strait of Çanakkale, collectively forming the Turkish Straits System. The annual microbial water quality status for the years 2022, 2023, and 2024 was assessed for a total of 176 bathing areas along the Sea of Marmara coast, monitored by the Turkish MoH during the bathing season (Figure 1). Lakes in the Marmara Basin were not included in the study.

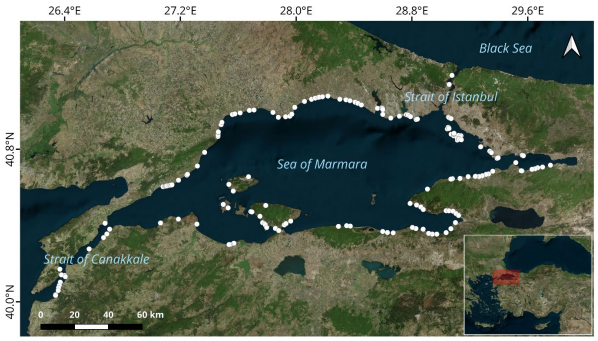

Figure 1. Study area and monitored bathing areas along the Turkish Strait System coast

Data compilation and analysis (2022-2024)

A list of monitored bathing areas along the Sea of Marmara, including Tekirdağ, İstanbul, Kocaeli, Yalova, Bursa, Balıkesir, and Çanakkale, was compiled from the Bathing Water Monitoring System of the MoH (https://yuzme.saglik.gov.tr). From the same system, annual water quality classification results were obtained for 176 beaches for the years 2022, 2023, and 2024, categorized as excellent, good, sufficient, or poor (Table S1). These classifications are determined by the MoH according to the RMBWQ (2019) as outlined in Table 1. This assessment is carried out at the end of the bathing season, using the data collected for that bathing season and the previous three. Waters exceeding the threshold for sufficient quality (Table 1) are classified as poor. Bathing areas that are added to the monitoring program later, without a continuous data set for four consecutive years, are not classified and are defined as new.

Table 1. Quality criteria and classifications for coastal and transitional waters under RMBWQ (2019)

	Water Quality Classification		
Indicator (CFU or MPN/100 ml)	**Excellent**	**Good**	**Sufficient**
E. coli	250*	500*	500**
Intestinal enterococci	100*	200*	185**

*Based on a 95th-percentile evaluation. Upper 95-percentile = antilog (μ+1,65 σ)
**Based on a 90th-percentile evaluation. Upper 90-percentile = antilog (μ+ 1,282 σ)
- μ is arithmetic mean of the log10 values and σ is standard deviation of the log10 values

In order to analyze temporal and spatial variations in bathing water quality, water quality data were first grouped by year and then by province, with the frequency of each quality category (excellent, good, sufficient, poor, and new) recorded accordingly. To examine associations between categorical variables, Pearson's Chi-Square Test was used to assess whether water quality classifications were independent of year and province. All statistical tests were performed at a significant level of $p<0.05$.

To evaluate changes in bathing water quality, we compared the classifications between 2022 and 2024 to determine whether individual sites showed improvement or degradation. If water quality remained consistent between 2022 and 2024, it was classified as unchanged, regardless of fluctuation in 2023. If a change in water quality was observed between 2022 and 2024, it was classified as either improved or degraded (Table S1). In addition, Blue Flag awarded beaches were identified through the Bathing Water Monitoring System and verified on the Blue Flag Türkiye website (Blue Flag Türkiye, n.d.). These beaches were then compared with the relevant water quality classifications to verify compliance with the Blue Flag criteria, which require excellent water quality status, and to identify any discrepancies.

RESULTS

Quality of bathing water in the Sea of Marmara: 2022-2024

Of the 1501 bathing waters monitored by the MoH Provincial Directorates of Health, 176 are located along the Sea of Marmara, including the Strait of İstanbul and the Strait of Çanakkale. These waters are assessed annually for microbial water quality during the bathing season. While the number of monitored beaches in the Sea of Marmara remained 176 in 2022 and 2023, it decreased to 174 in 2024. A review of the dataset revealed that "Yenice Marmara Sahil Sitesi" and "Eriklice Köyü Halk Plajı" in Tekirdağ, previously included in the monitoring, were excluded from the 2024 dataset.

The analysis of bathing water quality (2022–2024) showed a significant association between water quality classification and year (χ^2=15.94 and $p<0.05$), with an increase in the number of bathing areas classified as excellent. However, while the number of poor quality bathing areas remained stable in 2022 and 2023, it increased to 15 in 2024 (Figure 2). The proportion of bathing areas with excellent water quality ranged from 53% to 66%, which is relatively low compared to the European Union (EU) average.

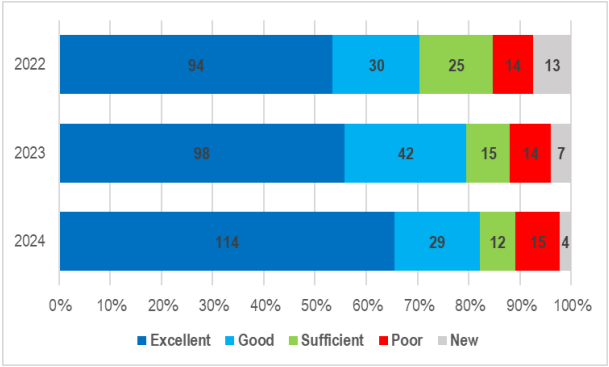

Figure 2. Bathing water quality status of the Sea of Marmara between 2022 and 2024. The numbers inside the boxes represent the absolute counts (n), n=176 for 2022 and 2023, and n=174 for 2024

In 2024, İstanbul had the highest number of monitored bathing waters (53), followed by Tekirdağ (30), Balıkesir (22), Bursa (20), and Yalova and Çanakkale (18 each). Kocaeli had the lowest number, with 13 monitored bathing waters (Figure 3). These variations likely reflect differences in coastline length and tourism potential. A significant association was found between water quality classification and province (χ^2 = 49.14 and $p < 0.05$). Balıkesir had the highest proportion of beaches with excellent water quality (95%), followed by Çanakkale (83%) and Kocaeli (69%). İstanbul (68%) and Tekirdağ (67%) represented the average level of water quality in the Sea of Marmara. In contrast, Yalova (28%) and Bursa (25%) exhibited the lowest bathing water quality, with 10 beaches classified as poor in 2024 (Figure 3).

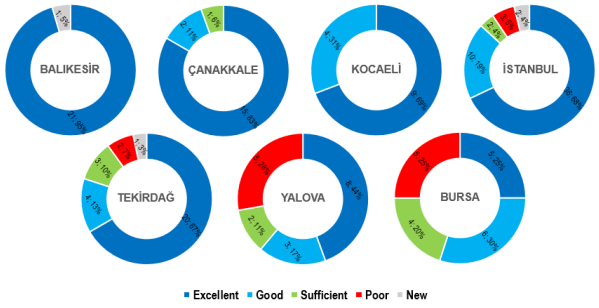

Figure 3. Bathing water quality status of the Sea of Marmara provinces in 2024. The first numbers represent the absolute counts (n); the second values indicate the relative proportion of each category as a percentage (%)

For the 2024 season, the number of samples collected per province ranged from 7 to 10, in accordance with regulatory criteria. The province with the highest number of samples during the season was Kocaeli with 10 samples, followed by Balıkesir with 9, and Yalova with 8. İstanbul and Bursa exhibited the lowest number of samples, with 7 each. In Tekirdağ and Çanakkale, the number of samples varies between 7 and 8. Among provinces, Kocaeli demonstrated the most consistent monitoring with two samples collected per month from May to September, ensuring a comprehensive assessment of bathing water quality.

An evaluation of bathing water quality changes over a three-year period revealed that water quality improved at 30 sites (18 in İstanbul, 4 in Bursa, 3 in Tekirdağ, 3 in Kocaeli, and 2 in Yalova), deteriorated at 14 sites (5 in Bursa, 3 in Tekirdağ, 3 in Yalova, 2 in İstanbul, and 1 in Çanakkale), and remained unchanged at 129 bathing areas. Among the provinces, İstanbul demonstrated the most significant improvement, with 18 beaches showing enhanced water quality. In contrast, Bursa experienced the highest level of degradation, with five beaches exhibiting a decline in microbial water quality (Table S1).

Blue Flag status in the Sea of Marmara: 2024

In 2024, a total of 567 beaches, 27 marinas, 9 individual yachts, and 18 tourism boats in Türkiye were awarded the Blue Flag. In this context, Türkiye ranks third in terms of the number of Blue Flag awarded beaches among the 51 countries participating in the Blue Flag Program, following Spain (639 beaches) and Greece (583 beaches) (Blue Flag, n.d.). Accordingly, 38% (567/1501) of the beaches that have their bathing water quality monitored in Türkiye have received the Blue Flag, with 27 of these located along the coast of the Sea of Marmara.

An analysis of Blue Flag beaches by province showed that Balıkesir and Tekirdağ led with eight Blue Flag beaches each. However, when considering the ratio of Blue Flag beaches to the total monitored beaches, Balıkesir and Çanakkale demonstrate the highest percentages of 36% and 28%, respectively (Table 2).

Table 2. The number and ratio of Blue Flag awarded beaches by province

	BF awarded beach numbers	Total beach numbers	BF awarded beach ratio
Balıkesir	8	22	36%
Tekirdağ	8	30	27%
Çanakkale	5	18	28%
Kocaeli	2	13	15%
Bursa	2	20	10%
İstanbul	1	53	2%
Yalova	1	18	6%
Sea of Marmara	27	174	16%

Of the 27 Blue Flag beaches in the Sea of Marmara, 26 demonstrated excellent water quality. However, Çanakkale Municipality Güzelyalı Public Beach was classified as good rather than excellent for the period 2022–2024.

DISCUSSION

This study evaluated the bathing water quality of the Sea of Marmara from 2022 to 2024, highlighting spatial and temporal trends, possible sources of contamination, and monitoring practices. The results showed that the proportion of bathing areas classified as excellent remained relatively low compared to the EU average, with values ranging between 53% and 66%. In contrast, the percentage of bathing areas with poor water quality has averaged 8% over the past three years, significantly exceeding the EU's 2023 average of 1.5% (European Environment Agency, 2024). The highest rates of poor water quality were recorded in Bursa and Yalova, where 10 beaches failed to meet the sufficient quality standard in 2024. Additionally, monitoring frequency varied between provinces, suggesting a lack of standardization in sampling practices.

The omission of two bathing areas from the 2024 dataset, may be due to a technical error in data entry. However, if no such error exists, the historical data for these beaches should remain accessible in the Bathing Water Monitoring System, along with an explanation for their removal to ensure transparency in the monitoring program.

In 2023, 85% of EU beaches met the excellent water quality standard (European Environment Agency, 2024). Notably, the bathing water quality of the Sea of Marmara (Figure 2) is more comparable to that of Poland (54.9%), Hungary (62.5%), and Estonia (66.2%) which recorded some of the lowest values among EU countries. However, it is important to note that assessments in these EU countries include both marine and inland waters, whereas the present study focuses solely on marine bathing areas. For the 2024 bathing season, 15 sites were classified as having poor water quality, 10 of which are located in Bursa and Yalova (Figure 2 and 3). Of these sites, 80% (12/15) are located near river mouths, while 20% (3/15) are close to piers or fishing ports. This suggests that microbial pollution originates primarily from riverine inputs or port activities. Previous studies have identified rivers (Basili et al., 2021; Bruschi et al., 2021; Ferrarin et al., 2021; Kataržytė et al., 2019) and port activities (Kraus et al., 2022) as potential contamination sources for bathing waters. Based on these findings, efforts to improve bathing water quality in the Sea of Marmara should prioritize Bursa and Yalova, followed by Tekirdağ and İstanbul (Figure 3).

The RMBWQ (2019) sets the number of samplings to be taken from bathing areas during the season at a minimum of five, including one sampling 15 days before the start of the monitoring calendar. Although the number of samples taken is sufficient for all provinces in the SoM according to the RMBWQ, the comparability of the results and the consistency of the assessment will be increased if the total number of samples taken for bathing areas in the same basin and under similar climatic conditions is as high and as equal as possible.

This study identified both improvements and deterioration in water quality across different locations. The measures implemented in İstanbul bathing areas, where the highest number of improvements in microbial water quality were observed, can serve as examples of best practices. In contrast, for bathing areas where degradation occurred, the relevant authorities from the MoH and the MoEUCC should ensure that an environmental assessment is conducted for these bathing areas within their operational areas where water quality has deteriorated, identify the factors contributing to this deterioration, and implement the necessary measures to minimize it.

Türkiye effectively implements regular monitoring of bathing waters. Despite this, there is a need for further efforts in disseminating monitoring results and related activities to ensure public awareness and engagement. As stated in the RMBWQ (2019), one of the objectives of the regulation is to inform the public about bathing water quality. For instance, a study from the UK reported that most beachgoers were unfamiliar with available water quality information (Quilliam et al., 2019). Similarly, other studies on beachgoers in Georgia, USA, found that 36.1% of visitors were unaware of regular water quality monitoring, and 64.7% considered the existing signage insufficient (Aslan et al., 2023; Jones et al., 2024). These examples highlight the common challenge of public awareness regarding water quality, which is also relevant to the Turkish context. A survey conducted in Türkiye as part of the Updating Swimming Water Profiles project reported that 73.2% of bathing sites have sufficient warning and informational signage, according to institutional representatives from relevant institutions (Yüksek et al., 2021). While this rate appears relatively high compared to findings from other studies, it is important to note that the survey responses came from institutional representatives rather than the general public. Another critical gap in public communication concerns short-term pollution events and beach closures. Currently, information regarding short-term pollution and beach closures is not available in the Bathing Water Monitoring System nor it reported. This highlights a gap in accessibility to real-time updates for beachgoers.

The limit values set for microbiological parameters in the Blue Flag Criteria Guide for Türkiye (TÜRÇEV, 2019) align with the excellent water quality criteria of the RMBWQ (Table 1). Similarly, in EU countries that implement the Blue Flag Program, applicant beaches must be classified as having excellent water quality to be awarded the Blue Flag (Foundation for Environmental Education, 2024). In light of these standards, the Blue Flag status of Güzelyalı Public Beach in Çanakkale should be re-evaluated, as it has maintained only good water quality over the past three years rather than excellent.

In a study conducted in the European Western Mediterranean Basin, Blue Flag beaches have significantly cleaner waters than non-Blue Flag beaches (Merino and Prats, 2022). However, in contrast to these findings, in the Sea of Marmara, 59 beaches, in addition to the 26 already awarded the Blue Flag, have maintained excellent water quality over the past three years. These beaches should be encouraged to meet the additional criteria for Blue Flag certification and apply for the designation. Expanding the number of Blue Flag beaches in the Sea of Marmara would further contribute to sustainable beach management, as previous studies have demonstrated that Blue Flag certification promotes tourism (Castillo-Manzano et al., 2021) and environmentally responsible coastal practices (Albaladejo-García and Zabala, 2023; Merino and Prats, 2020).

CONCLUSION

This study evaluated the bathing water quality of the Sea of Marmara for the period 2022–2024 and provided a summary of the current status of bathing waters and their monitoring practices. The results revealed that the proportion of bathing areas with excellent water quality in the Sea of Marmara lagged behind the European Union average of 85%. In the regional assessment, Balıkesir and Çanakkale provinces have a high percentage of beaches with excellent water quality, while Bursa and Yalova have significantly higher rates of poor water quality. Additionally, discrepancies in the number of samples collected per province suggest a lack of standardization in monitoring practices. In the context of the Blue Flag Program, 16% of the monitored beaches in the Sea of Marmara were found to have received Blue Flag certification. However, the criteria compliance should be reviewed at Güzelyalı Public Beach in Çanakkale.

In line with the findings of this study, the following recommendations are proposed to enhance the transparency and effectiveness of bathing water quality monitoring in the Sea of Marmara and Türkiye. Firstly, it is necessary to improve public access to water quality information by ensuring clear dissemination of monitoring results and potential health risks. In this way, public engagement must be encouraged by enabling citizens to verify monitoring activities and requesting additional water quality analyses when needed. In addition, it is important to prepare annual regional and national reports summarizing the monitoring results, including beach closure information during the relevant bathing season. These recommendations aim to ensure the transparent management of bathing water quality and improve public access to information. Finally, it is also important to increase training and awareness programs for bathing area managers, health officials, and relevant institutions to improve consistency and quality in monitoring.

Implementation of all these steps will significantly contribute to better bathing water management, protecting public health and contributing positively to tourism and the local economy in the Sea of Marmara.

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AUTHORSHIP CONTRIBUTIONS

Sibel Zeki: Conceptualization, Methodology, Investigation, Visualization, Methodology, Data Curation, Writing-Original Draft Preparation, Writing-Reviewing and Editing.

CONFLICT OF INTEREST

The author declares no competing interests.

ETHICS APPROVAL

No specific ethical approval was necessary for this study.

DATA AVAILABILITY

The data sets generated for the present study are available from the corresponding author upon reasonable request.

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Table S1. Annual water quality classification of 176 beaches for the years 2022, 2023, and 2024 in the Sea of Marmara

Name of Bathing Area	District/Province	Coordinates	Blue Flag	Bathing Water Quality			Water quality change from 2022 to 2024	Sample number in 2024
				2022	2023	2024		
Kovalık Mevki Halk Plajı	Şarköy/Tekirdağ	40.605164, 27.080686		Excellent	Excellent	Excellent	unchanged	8
Marmara Evleri Önü 19 Halk Plajı	Şarköy/Tekirdağ	40.606666, 27.094078		Excellent	Excellent	Excellent	unchanged	8
Süleyman Altınok Halk Paljı	Şarköy/Tekirdağ	40.606806, 27.094926	yes	Excellent	Excellent	Excellent	unchanged	8
Belediye Sosyal Tesisleri Önü	Şarköy/Tekirdağ	40.607799, 27.099890	yes	Excellent	Excellent	Excellent	unchanged	8
Tekirdağ B.B Atatürk Parkı Halk Plajı	Şarköy/Tekirdağ	40.608693, 27.104240	yes	Excellent	Excellent	Excellent	unchanged	8
Marmara Evleri Önü	Şarköy/Tekirdağ	40.609714, 27.107537	yes	Excellent	Excellent	Excellent	unchanged	8
Tekirağ B.B Şarköy 1 Nolu Halk Plajı	Şarköy/Tekirdağ	40.610966, 27.121842	yes	Excellent	Excellent	Excellent	unchanged	8
SSK Evleri (Halı Saha) Önü Plajı	Şarköy/Tekirdağ	40.612464, 27.130165		Excellent	Excellent	Excellent	unchanged	8
SSK Evleri Önü Halk Plajı	Şarköy/Tekirdağ	40.613162, 27.133179		Excellent	Excellent	Excellent	unchanged	8
Tekirdağ B.B. Şarköy 2 Nolu Halk Plajı	Şarköy/Tekirdağ	40.614420, 27.141701	yes	Excellent	Excellent	Excellent	unchanged	8
Eriklice Köyü Halk Plajı	Şarköy/Tekirdağ	40.639086, 27.186991		Excellent	Excellent		unchanged	
23 Nisan Kafe Önü Plajı	Şarköy/Tekirdağ	40.665530, 27.245124	yes	Excellent	Excellent	Excellent	unchanged	8
Mürefte Halk Plajı	Şarköy/Tekirdağ	40.669447, 27.249107	yes	Excellent	Excellent	Excellent	unchanged	8
Hoşköy Sağlık Ocağı Önü	Şarköy/Tekirdağ	40.712965, 27.317436		Excellent	Excellent	Excellent	unchanged	8
Uçmakdere Halk Plajı	Şarköy/Tekirdağ	40.784101, 27.367610		Excellent	Excellent	Excellent	unchanged	8
Kumbağ Balıkçıbarınağı Yanı Halk Plajı	Süleymanpaşa/Tekirdağ	40.867145, 27.459877		Excellent	Good	Good	degraded	8
Kumbağ Belediye Plajı	Süleymanpaşa/Tekirdağ	40.875168, 27.460346		Excellent	Good	Excellent	unchanged	8
Kumbağ Askeri Kampı	Süleymanpaşa/Tekirdağ	40.887931, 27.461809		Sufficient	Excellent	Excellent	improved	8
Barbaros Gündal Halk Plajı	Süleymanpaşa/Tekirdağ	40.890607, 27.462111		Excellent	Excellent	Excellent	unchanged	8
Barboros Topağaç Halk Plajı	Süleymanpaşa/Tekirdağ	40.928889, 27.482161		Good	Excellent	Excellent	improved	8
Altınova Halk Plajı	Süleymanpaşa/Tekirdağ	40.940399, 27.486915		Good	Good	Excellent	improved	8
Dereağzı Halk Plajı	Süleymanpaşa/Tekirdağ	40.980992, 27.559614		Poor	Poor	Poor	unchanged	7
Değirmenaltı Halk Plajı	Süleymanpaşa/Tekirdağ	40.984311, 27.576404		Sufficient	Poor	Poor	degraded	7
Beyazköy Şekerkamp Halk Plajı	Süleymanpaşa/Tekirdağ	40.989594, 27.612953		Excellent	Good	Good	degraded	7
Tekirdağ Salat Yağ Fabrikası Çamlık Plajı	Süleymanpaşa/Tekirdağ	41.002700, 27.676993		Sufficient	Sufficient	Sufficient	unchanged	7
Yenice Marmara Sahil Sitesi Önü	Çorlu/Tekirdağ	41.004795, 27.708841		Good	Good		unchanged	
Yeniçiftlik Halk Plajı	Marmaraereğlisi/Tekirdağ	40.991948, 27.839896		Sufficient	Good	Sufficient	unchanged	7
Marmara Ereğlisi Kaptan 2 Önü Halk Plajı	Marmaraereğlisi/Tekirdağ	40.966875, 27.876812		Good	Excellent	Good	unchanged	8
Dallas Kampı Halk Plajı	Marmaraereğlisi/Tekirdağ	40.969443, 27.927013		Good	Good	Good	unchanged	8
Marmara Ereğlisi Halk Plajı	Marmaraereğlisi/Tekirdağ	40.972310, 27.956284		Sufficient	Sufficient	Sufficient	unchanged	7
Kamaradere Halk Plajı	Marmaraereğlisi/Tekirdağ	40.982728, 27.969820		New	New	New	unchanged	7
Sultanköy Halk Plajı	Marmaraereğlisi/Tekirdağ	41.018287, 27.990545		Excellent	Excellent	Excellent	unchanged	7
Gümüsyaka Belediye Çadır Yeri Mevkii	Silivri/İstanbul	41.049080, 28.057666		Sufficient	Good	Good	improved	7
Çanta Albayraklar-Kınalı Mevki Önü	Silivri/İstanbul	41.060031, 28.105983		Excellent	Excellent	Excellent	unchanged	7
Uyumkent Sitesi Önü	Silivri/İstanbul	41.066498, 28.132422		Excellent	Excellent	Excellent	unchanged	7

Table S1. Continued.

Name of Bathing Area	District/Province	Coordinates	Blue Flag	Bathing Water Quality			Water quality change from 2022 to 2024	Sample number in 2024
				2022	2023	2024		
Semizkum Basınkent 4 Site Önü	Silivri/İstanbul	41.069910, 28.153613		Excellent	Excellent	Excellent	unchanged	7
Semizkum Çadır ve Kamp Yeri	Silivri/İstanbul	41.071680, 28.161011		Excellent	Excellent	Excellent	unchanged	7
Altınorak Sitesi Önü	Silivri/İstanbul	41.073319, 28.181972		Excellent	Excellent	Excellent	unchanged	7
Silivri Kumluk Mevkii	Silivri/İstanbul	41.077044, 28.219787	yes	Excellent	Excellent	Excellent	unchanged	7
Bizimköy-Parkköy Sitesi Önü	Silivri/İstanbul	41.060435, 28.301813		Good	Good	Excellent	improved	7
Selimpasa Baskent Sitesi Önü	Silivri/İstanbul	41.057522, 28.344377		Good	Good	Excellent	improved	7
Selimpasa Duruman Mevkii	Silivri/İstanbul	41.052939, 28.371773		Good	Good	Excellent	improved	7
Celaliye Beldesi Belediye Tesisleri Önü	Büyükçekmece/İstanbul	41.045236, 28.407311		Poor	Good	Good	improved	7
Kamiloba Beldesi Ağar Kamping Önü	Büyükçekmece/İstanbul	41.039468, 28.426275		Sufficient	Good	Excellent	improved	7
Kumburgaz Plajı	Büyükçekmece/İstanbul	41.030679, 28.450827		Good	Good	Good	unchanged	7
Mimarsinan Sahili	Büyükçekmece/İstanbul	41.013153, 28.561752		Sufficient	Good	Excellent	improved	7
Büyükçekmece Halk Plajı	Büyükçekmece/İstanbul	41.015874, 28.590863		Good	Good	Good	unchanged	7
Büyükçekmece Çocuk Sahili	Büyükçekmece/İstanbul	41.014015, 28.595287		Sufficient	Good	Good	unchanged	7
Albatros Sahili	Büyükçekmece/İstanbul	41.012666, 28.597040		Good	Good	Excellent	improved	7
Gürpinar Sahili	Büyükçekmece/İstanbul	41.006721, 28.598745		Excellent	Excellent	Excellent	unchanged	7
Beylikdüzü Gürpinar Sahili Halk Plaj	Beylikdüzü/İstanbul	40.981508, 28.598711		Good	Good	Excellent	improved	7
West İstanbul Marina Plajı	Beylikdüzü/İstanbul	40.962808, 28.653902		Sufficient	Poor	Poor	degraded	8
Denizköşkler	Avcılar/İstanbul	40.972319, 28.713483		New	Good	Good	unchanged	7
Menekşe Plajı Sahil Parkı Önü	Küçükçekmece/İstanbul	40.980518, 28.761041		Poor	Good	Sufficient	improved	7
Menekse Plajı Cankurtaran Kulesı Önü	Küçükçekmece/İstanbul	40.979062, 28.770776		Poor	Sufficient	Good	improved	7
Menekse Plajı Iskele Önü	Küçükçekmece/İstanbul	40.977433, 28.774018		Poor	Sufficient	Good	improved	7
Florya Güneş Plajı	Bakırköy/İstanbul	40.969993, 28.789924		New	New	New	unchanged	7
Yesilköy Polis Merkezi Önü	Bakırköy/İstanbul	40.955219, 28.829444		Sufficient	Sufficient	Poor	degraded	7
Yeşilköy international Hospital Önü	Bakırköy/İstanbul	40.957325, 28.837974		Poor	Poor	Poor	unchanged	7
Tarabya Plajı	Sarıyer/İstanbul	41.137100, 29.057890		Sufficient	Good	Good	improved	7
Rumeli Kavagı Plajı	Sarıyer/İstanbul	41.184322, 29.076590		Sufficient	Sufficient	Sufficient	unchanged	7
Caddebostan Plajı Büyük Kulüp Arkası	Kadıköy/İstanbul	40.967511, 29.052877		Good	Good	Excellent	improved	7
Caddebostan Plajı Irmak Okulları Arkası	Kadıköy/İstanbul	40.964281, 29.057729		Good	Good	Excellent	improved	7
Suadiye Plajı	Kadıköy/İstanbul	40.959965, 29.070769		Good	Good	Excellent	improved	7
Kınalıada Ülker Restaurant Önü	Adalar/İstanbul	40.906427, 29.044207		Good	Excellent	Excellent	improved	7
Kınalıada Su Sporları Kulübü Önü	Adalar/İstanbul	40.914504, 29.050315		Excellent	Excellent	Excellent	unchanged	7
Kınalıada Vapur Iskelesı Sag Taraf Önü	Adalar/İstanbul	40.911514, 29.054934		Excellent	Excellent	Excellent	unchanged	7
Kınalıada Vapur Iskelesı Sol Taraf Önü	Adalar/İstanbul	40.908268, 29.056040		Excellent	Excellent	Excellent	unchanged	7
Burgazada Su Sporları Kulübü Önü	Adalar/İstanbul	40.878801, 29.071783		Excellent	Excellent	Excellent	unchanged	7
Burgazada Deniz Kulübü	Adalar/İstanbul	40.878697, 29.070994		New	Excellent	Excellent	unchanged	7

Table S1. Continued.

Name of Bathing Area	District/Province	Coordinates	Blue Flag	Bathing Water Quality			Water quality change from 2022 to 2024	Sample number in 2024
				2022	2023	2024		
Heybeliada Ada Beach Club Önü	Adalar/İstanbul	40.870617, 29.088226		Excellent	Excellent	Excellent	unchanged	7
Heybeliada Asaf Beach	Adalar/İstanbul	40.879485, 29.088573		New	Excellent	Excellent	unchanged	7
Heybeliada Sadıkbey Plajı Önü	Adalar/İstanbul	40.880482, 29.090188		Excellent	Excellent	Excellent	unchanged	7
Heybeliada Su Sporları Kulübü Önü	Adalar/İstanbul	40.882312, 29.088921		Excellent	Excellent	Excellent	unchanged	7
Değirmenburnu Tabiat Parkı Plajı	Adalar/İstanbul	40.883335, 29.090919		New	New	New		7
Halik Koyu Eskibag Mesire Alanı Halk Plajı	Adalar/İstanbul	40.848355, 29.113735		Good	Good	Excellent	improved	7
Büyükada Prenses Koyu	Adalar/İstanbul	40.858878, 29.112632		New	Excellent	Excellent	unchanged	7
Büyükada Yörükalı Plajı Önü	Adalar/İstanbul	40.859599, 29.112769		Excellent	Excellent	Excellent	unchanged	7
Büyükada Kayıkhane Blue Beach	Adalar/İstanbul	40.872431, 29.122753		Excellent	Excellent	Excellent	unchanged	7
Büyükada Su Sporları Kulübü Önü	Adalar/İstanbul	40.870556, 29.139156		Excellent	Excellent	Excellent	unchanged	7
Büyükada Nakıbey Plajı	Adalar/İstanbul	40.863668, 29.133911		Excellent	Excellent	Excellent	unchanged	7
Büyükada Aya Nikola Halk Plajı	Adalar/İstanbul	40.854298, 29.125331		Excellent	Excellent	Excellent	unchanged	7
Büyükada Tabiat Parkı Plajı	Adalar/İstanbul	40.852641, 29.125507		Excellent	Excellent	Excellent	unchanged	7
Sedef Adası Halk Plajı	Adalar/İstanbul	40.849850, 29.141486		Excellent	Excellent	Excellent	unchanged	7
Tuzla Belediyesi Halk Plajı	Tuzla/İstanbul	40.813139, 29.275073		Good	Excellent	Good	unchanged	7
Bayramoğlu Ada	Darıca/Kocaeli	40.790361, 29.337584		Sufficient	Good	Good	improved	10
Kadınlar Plajı	Darıca/Kocaeli	40.783901, 29.348597		Sufficient	Good	Good	improved	10
Bayramoğlu Halk	Darıca/Kocaeli	40.782567, 29.349454		Good	Good	Good	unchanged	10
Balyanoz Koyu Plajı	Darıca/Kocaeli	40.753105, 29.388674		New	New	Good	unchanged	10
Darıca Ş.Er Gökhan Hüseyinoğlu Sahil Parkı Plajı	Darıca/Kocaeli	40.755639, 29.395530		Good	Excellent	Excellent	improved	10
Tavşancıl	Dilovası/Kocaeli	40.769301, 29.562482		Excellent	Excellent	Excellent	unchanged	10
Tavşancıl Sahili 2	Dilovası/Kocaeli	40.766560, 29.570316		New	Excellent	Excellent	unchanged	10
Halıdere	Gölcük/Kocaeli	40.717179, 29.757211		Excellent	Excellent	Excellent	unchanged	9
Ulaşlı Haık Plajı	Gölcük/Kocaeli	40.707384, 29.702787		Excellent	Excellent	Excellent	unchanged	10
Güzelkıyı Sahili	Karamürsel/Kocaeli	40.703854, 29.669009		Excellent	Excellent	Excellent	unchanged	10
Ereğli Kumyalı Defne	Karamürsel/Kocaeli	40.698482, 29.650082	yes	Excellent	Excellent	Excellent	unchanged	10
Altınkemer	Karamürsel/Kocaeli	40.695678, 29.629647	yes	Excellent	Excellent	Excellent	unchanged	10
Dereköy Sahili	Karamürsel/Kocaeli	40.687053, 29.560087		Excellent	Excellent	Excellent	unchanged	10
Saralkent Sahili	Altınova/Yalova	40.688025, 29.555197	yes	Excellent	Excellent	Excellent	unchanged	8
Hersek Sahili	Altınova/Yalova	40.730719, 29.517622		Excellent	Good	Excellent	unchanged	8
Aydınkent-Ceylankent Sahili	Çiftlikköy/Yalova	40.685507, 29.358296		Excellent	Excellent	Excellent	unchanged	8
Baskent 3 Sıtesı Plajı	Çiftlikköy/Yalova	40.671495, 29.329224		Poor	Poor	Poor	unchanged	8
Çiftlikköy Halk Plajı	Çiftlikköy/Yalova	40.669153, 29.312164		Poor	Poor	Sufficient	improved	8
Arastırma Sahili Plajı	Merkez/Yalova	40.662408, 29.286469		Sufficient	Sufficient	Poor	degraded	8
Akasya Park Plajı	Merkez/Yalova	40.658153, 29.264047		Sufficient	Poor	Poor	degraded	8

Table S1. Continued.

Name of Bathing Area	District/Province	Coordinates	Blue Flag	Bathing Water Quality			Water quality change from 2022 to 2024	Sample number in 2024
				2022	2023	2024		
Su Ürünleri Plajı	Merkez/Yalova	40.659448, 29.242248		Poor	Poor	Poor	unchanged	8
Kamplar Bölgesi Plajı	Merkez/Yalova	40.658871, 29.238005		Good	Good	Good	unchanged	8
Koru Halk Plajı	Çınarcık/Yalova	40.657429, 29.188486		Sufficient	Sufficient	Sufficient	unchanged	8
Taslıman Mevkii Plajı	Çınarcık/Yalova	40.648267, 29.131986		Excellent	Excellent	Excellent	unchanged	8
Üçreisler Özenler Mevkii Plajı	Çınarcık/Yalova	40.646639, 29.079767		Sufficient	Sufficient	Poor	degraded	8
Kumluk Mavıs Plajı	Çınarcık/Yalova	40.644513, 29.068776		Excellent	Excellent	Excellent	unchanged	8
Esenköy Çamlıbel Mevkii	Çınarcık/Yalova	40.592205, 28.907283		Excellent	Good	Excellent	unchanged	8
İhlas Armutlu Tatil Koyu Plajı	Armutlu/Yalova	40.517341, 28.787403		Excellent	Excellent	Excellent	unchanged	8
İskele Mevkii	Armutlu/Yalova	40.508903, 28.832107		Sufficient	Sufficient	Excellent	improved	8
Yılandar Mevkii Plajı	Armutlu/Yalova	40.498841, 28.861102		Good	Good	Good	unchanged	8
Fıstıklı Köy Sahili	Armutlu/Yalova	40.485600, 28.878375		Good	Sufficient	Good	unchanged	8
Narlı Halk Plajı	Gemlik/Bursa	40.479217, 29.036347		Good	Good	Good	unchanged	7
Karacaali Gençlik Kampı	Gemlik/Bursa	40.478509, 29.056135		Good	Good	Good	unchanged	7
Büyükkumla Halk Plajı	Gemlik/Bursa	40.476489, 29.084309		Good	Sufficient	Sufficient	degraded	7
B.B.B. Küçükkumla Halk Plajı	Gemlik/Bursa	40.464170, 29.104912		Poor	Poor	Poor	unchanged	7
Hasanağa Kadınlar Plajı	Gemlik/Bursa	40.454352, 29.122133		Poor	Poor	Poor	unchanged	7
Gemsaz Halk Plajı	Gemlik/Bursa	40.416962, 29.100608		Good	Good	Good	unchanged	7
B.B.B. Kumsaz Halk Plajı	Gemlik/Bursa	40.384925, 29.069430		Poor	Poor	Sufficient	improved	7
B.B.B.Kurşunlu Kadınlar Plajı	Gemlik/Bursa	40.364283, 29.036363		Poor	Poor	Sufficient	improved	7
Altıntaş Halk Plajı	Mudanya/Bursa	40.356554, 28.971953		New	New	Excellent	unchanged	7
Burgaz Altınkum Halk Plajı	Mudanya/Bursa	40.356801, 28.940741		Sufficient	Poor	Poor	degraded	7
Burgaz Halk Plajı	Mudanya/Bursa	40.360564, 28.915482		Sufficient	Sufficient	Poor	degraded	7
Coşkunöz Halk Plajı	Mudanya/Bursa	40.382264, 28.877543		Sufficient	Sufficient	Sufficient	unchanged	7
Kumyaka Halk Plajı	Mudanya/Bursa	40.385797, 28.827732		Poor	Poor	Poor	unchanged	7
Zeytinbağı Halk Plajı	Mudanya/Bursa	40.391404, 28.803451		Good	Good	Excellent	improved	7
B.B.B. Eskel Halk Plaji	Mudanya/Bursa	40.362955, 28.670669		Sufficient	Good	Excellent	improved	7
B.B.B. Egerce Halk Plaji	Mudanya/Bursa	40.364926, 28.630684		Good	Good	Good	unchanged	7
B.B.B. Mesudiye Halk Plajı	Mudanya/Bursa	40.370194, 28.598117		Excellent	Good	Good	degraded	7
Yeniköy Halk Plaji	Karacabey/Bursa	40.398482, 28.374206		Excellent	Good	Good	degraded	7
Malkara Halk Plaji	Karacabey/Bursa	40.400727, 28.348805	yes	Excellent	Excellent	Excellent	unchanged	7
Kursunlu Halk Plaji / Karacabey	Karacabey/Bursa	40.397140, 28.292495	yes	Excellent	Excellent	Excellent	unchanged	7
Tatlısu Mah. Halk Plajı Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.405014, 27.918214		Excellent	Excellent	Excellent	unchanged	9
Bakraç Plajı-Tatlısu Mevkii Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.411760, 27.930055	yes	Excellent	Excellent	Excellent	unchanged	9
Dalyan Plajı-Tatlısu Mevkii Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.424894, 27.962442	yes	Excellent	Excellent	Excellent	unchanged	9

Table S1. Continued.

Name of Bathing Area	District/Province	Coordinates	Blue Flag	Bathing Water Quality			Water quality change from 2022 to 2024	Sample number in 2024
				2022	2023	2024		
Turan Mah. Halk Plajı Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.506795, 27.790100		Excellent	Excellent	Excellent	unchanged	9
Moda Plajı Narlı Mevkii Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.474492, 27.687026	yes	Excellent	Excellent	Excellent	unchanged	9
Laka Plajı Narlı Mevkii Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.472833, 27.694301		Excellent	Excellent	Excellent	unchanged	9
Ocaklar Belediye Plajı Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.450070, 27.749723	yes	Excellent	Excellent	Excellent	unchanged	9
Toma Deresi Mev. Çugra Plajları Yüz. Su. İz. Nok.	Erdek/Balıkesir	40.416345, 27.768357		Excellent	Excellent	Excellent	unchanged	9
Kafkas Otel Çugra Mevkii Yüzme Suyu İz. Noktası	Erdek/Balıkesir	40.410060, 27.782051		Excellent	Excellent	Excellent	unchanged	9
Orman Kampı Mevkii Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.405515, 27.786261		Excellent	Excellent	Excellent	unchanged	9
Kurbağalıdere Mevkii Yüzme Suyu İzleme Noktası	Erdek/Balıkesir	40.391191, 27.796135	yes	Excellent	Excellent	Excellent	unchanged	9
Pınar Otel Plajı-Gedeve Mevkii Yüzme Suyu İz. Nok.	Erdek/Balıkesir	40.386816, 27.856198	yes	Excellent	Excellent	Excellent	unchanged	9
Edincik Altı Halk Plajı Yüzme Suyu İzleme Noktası	Bandırma/Balıkesir	40.375308, 27.879595		Excellent	Excellent	Excellent	unchanged	9
Saraylar Abroz Plajı Yüzme Suyu İzleme Noktası	Marmara/Balıkesir	40.656692, 27.671027	yes	Excellent	Excellent	Excellent	unchanged	9
Çınarlı Sahili Yüzme Suyu İzleme Noktası	Marmara/Balıkesir	40.616850, 27.535073		New	New	New		9
Aba Plajı Yüzme Suyu İzleme Noktası	Marmara/Balıkesir	40.582190, 27.565425		Excellent	Excellent	Excellent	unchanged	9
Avşa Halk Plajı Yüzme Suyu İzleme Noktası	Marmara/Balıkesir	40.512200, 27.496083	yes	Excellent	Excellent	Excellent	unchanged	9
Yiğitler Halk Plajı Yüzme Suyu İzleme Noktası	Marmara/Balıkesir	40.494083, 27.530241		Excellent	Excellent	Excellent	unchanged	9
Sendika Önü Yüzme Suyu İzleme Noktas	Gönen/Balıkesir	40.308702, 27.569719		Excellent	Excellent	Excellent	unchanged	9
Pınarkent Yüzme Suyu İzleme Noktası	Gönen/Balıkesir	40.302305, 27.546329		Excellent	Excellent	Excellent	unchanged	9
66 Evler Plajı Yüzme Suyu İzleme Noktası	Gönen/Balıkesir	40.301795, 27.540503		Excellent	Excellent	Excellent	unchanged	9
Akınkent Yüzme Suyu İzleme Noktası	Gönen/Balıkesir	40.301757, 27.535793		Excellent	Excellent	Excellent	unchanged	9
Karabıga Halk Plajı	Biga/Çanakkale	40.408972, 27.314188	yes	Excellent	Excellent	Excellent	unchanged	8
Aksaz Halk Plajı	Biga/Çanakkale	40.435111, 27.186333		Excellent	Excellent	Excellent	unchanged	8
Kemer Halk Plajı	Biga/Çanakkale	40.414757, 27.062819		Excellent	Excellent	Excellent	unchanged	8
Çardak Halk Plajı	Lapseki/Çanakkale	40.382360, 26.711374		Excellent	Excellent	Excellent	unchanged	8
Belediye Plajı (Dalyan)	Lapseki/Çanakkale	40.357195, 26.691874		Excellent	Excellent	Excellent	unchanged	8
Kökez Mevkıı Plajı	Lapseki/Çanakkale	40.338421, 26.669528		Excellent	Excellent	Excellent	unchanged	8
Umurbey Sahil	Lapseki/Çanakkale	40.278638, 26.569475		New	New	Excellent		8
Mega Beach Önü Belediye Halk Plajı	Merkez/Çanakkale	40.139309, 26.399981		Excellent	Excellent	Excellent	unchanged	8
Yenıkordon Barış Plajı	Merkez/Çanakkale	40.132766, 26.405264	yes	Excellent	Excellent	Excellent	unchanged	7
Kepez Halk Plajı	Merkez/Çanakkale	40.103829, 26.370265	yes	Excellent	Excellent	Excellent	unchanged	8
Dardanos Halk Plajı	Merkez/Çanakkale	40.087163, 26.363751	yes	Excellent	Excellent	Excellent	unchanged	7
Dardanos Orman Kampı Yanı Plajı	Merkezçanakkale	40.074441, 26.358132		Excellent	Excellent	Excellent	unchanged	8
Özel Eğitim Merkezi Komutanlığı Plajı	Merkezçanakkale	40.060142, 26.356016		New	Excellent	Excellent	unchanged	8
Güzelyalı Belediye Halk Plajı	Merkez/Çanakkale	40.037943, 26.337731	yes	Good	Good	Good	unchanged	7
Intepe Gençlık Kampı	Merkez/Çanakkale	40.034371, 26.337274		Excellent	Excellent	Good	degraded	8

Table S1. Continued.

Name of Bathing Area	District/Province	Coordinates	Blue Flag	Bathing Water Quality			Water quality change from 2022 to 2024	Sample number in 2024
				2022	2023	2024		
Kılıtbahır Zargana Plajı	Eceabat/Çanakkale	40.142417, 26.378484		Excellent	Excellent	Excellent	unchanged	8
Eceabat Plajı	Eceabat/Çanakkale	40.172302, 26.367459		Sufficient	Sufficient	Sufficient	unchanged	8
Hamzakoy Plajı	Gelibolu/Çanakkale	40.413573, 26.679640		Excellent	Excellent	Excellent	unchanged	8