Microplastic Pollution in the Middle Ground Fishing Zone of the Bay of Bengal: Abundance, Morphology and Preliminary Risk Assessment

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ABSTRACT: Microplastics have become a global environmental concern in the 21st century due to their ubiquitous presence, particularly in the marine ecosystem. The current study investigated the occurrence, abundance, and distributional pattern of microplastics in the surface water of one of the most crucial fishing grounds in Bangladesh, the Middle Ground of the Bay of Bengal (BoB). The region is currently unexplored, despite the ongoing research on microplastics all over the world as well as in Bangladesh. Field sampling from 9 stations was conducted for water samples, and they were subsequently processed, digested, physically identified, and quantified. The mean abundance of microplastics was 2307 ± 2.9 microplastics/m^3, while relative abundance of morphological shapes observed was pellets, fibers, foam, fragments, and film. However, transparent microplastics were the most dominant in terms of color. Smaller-sized particles (<0.5 mm) were predominant among the microplastic fractions. Based on risk assessments, the region falls under hazard category I, suggesting a minor risk. It was the first such investigation ever in the Middle Ground of the BoB, Bangladesh; therefore, the result of this study is expected to pioneer others and help mitigate policy implications for microplastic pollution in the BoB.

Keywords: Bay of Bengal; Fishing Ground; Pollution; Microplastics; Abundance

INTRODUCTION

Plastics' versatility makes them widely used in daily life around the world. Worldwide annual plastic production expanded progressively between 1950 and 2023, rising from 1.7 (Wang et al., 2020) to 413.8 million tons (Statista Research Department, 2025). However, this widespread use has led to a corresponding rise in plastic pollution. Various biogeochemical processes, including microbial degradation, biodeterioration, bio-fragmentation, photochemical oxidation, electrochemical oxidation, and photocatalytic degradation (Thakur et al., 2023), break down plastics into smaller particles over time (Lin et al., 2018) that eventually turn into microplastics (<5 mm). It causes the microplastic to be found all over the world, including oceans, from mid-ocean islands and subtropical gyres to remote regions like the Arctic (Ajith et al., 2020). Microplastics pose a significant threat to marine ecosystems. Ingestion and blockage, entanglement, toxicity, growth and reproductive inhibition, and delayed maturity are just a few of the examples that negatively impact the marine biota (the vertebrates, invertebrates, plankton, and even detritivores) via microplastics upon consumption of these particles (Ugwu et al., 2021). Moreover, microplastics can leach additional chemicals from manufacturing processes_(Li et al., 2024) or act as vectors for other pollutants (Zambrano-Pinto et al., 2024). Both plastic additive chemicals and plastic-adsorbed chemical pollutants (e.g., DDT, heavy metals, and oil compounds) can leach from microplastics and pose a threat to sea creatures and the environment (Kibria et al., 2023). So, microplastics are a potential threat to the environment, both in crowded areas and inaccessible remote oceans (Horton and Barnes, 2020).

Bay areas are particularly vulnerable to plastic pollution (Eriksen et al., 2014). Microplastic distribution in these locales is mostly determined by complex hydrodynamics influenced by wind and tidal currents (Strafella et al., 2021). One of the world's greatest marine ecosystems, the Bay of Bengal (BoB), yields 6

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million tons of fish annually, which is about 4% of the world's total catch (Islam, 2019). This fish population supports both maritime trade and tourism. However, the fast-paced urbanization, population expansion, and industrialization are accelerating the pollution levels. Asia's newest plastic hotspots are the BoB and the South China Sea. Annually, about 2 lakh tons of plastics enter the BoB from Bangladesh. Bangladesh is the 10th most plastic-polluted country in the world (Islam, 2019). Population pressure, poor waste management practices, and shipbreaking are primarily responsible for this. Every year, 60-65 ships are broken in Chattogram and Khulna (Islam, 2019); it's predicted that marine MP abundance will exceed even the fish stock by 2050 if the status quo remains (Banik et al., 2024).

Though early decades have seen various research conducted on microplastics, all were in inland and coastal areas (Tajwar et al.,2022a; Tajwar et. al., 2022b; Hossain et al.,2021; Rahman et al., 2020). Globally, microplastic pollution has been studied in a variety of environments, from the surface waters of the Mediterranean Sea , the subtropical gyres , and the Arctic to the coastal and estuarine regions of Southeast Asia (Mutuku et al., 2024; Simon-Sánchez et al., 2022). In Bangladesh, however, the focus has remained primarily on rivers (e.g., Buriganga and Karnaphuli) and estuarine zones like the Meghna Estuary and the Cox's Bazar coast (Haque et al., 2022). These studies identified rivers and urban runoffs as major plastic conduits into marine systems. Despite these findings, no prior research has assessed the distribution of microplastics in the Middle Ground, a key fishing area. The region is one of the four major fishing grounds in the BoB and demands attention to assess microplastic distribution and variation over time. The rest of the three are south patches, south of south patches, and swatch of no ground (Iqbal et al., 2011).

Crucial roles in pollution mitigation should be played by government authorities and stakeholders through policy implications. However, the main gap that needs to be bridged is the lack of comprehensive data on microplastic pollution. It stems from the lack of study in crucial locales, including the Middle Ground of the Bay of Bengal. To bridge the gap, this study is the first attempt ever to assess the current status of microplastic pollution in the middle ground of the BoB. It aims to generate baseline data on microplastic abundance and particle characteristics (shape, size, and color), which can inform future monitoring and policy interventions. In this context, this study specifically assessed microplastic abundance in the surface water, characterized morphological shape features, size, and colors; assessed ecological risks. Future work should incorporate sediments and marine organisms. This study will offer essential baseline data for a previously unassessed region. The results will help shape policies targeted at lowering plastic pollution in the BOB and offer important insights into the degree of pollution**.**

MATERIALS AND METHODS

Study Area and Sampling

The middle ground of the Bay of Bengal was chosen to be the study area **(**Fig. 1**)**. Tropical climate shapes the Middle Ground of the BoB by warmth and humidity throughout the year (Li et al., 2021). The BoB covers 2,173,001.61 km^2 (Fernando, 2018) and is a shallow embayment in the northeastern Indian Ocean. The current study area, the Middle Ground, falls within this very bay and serves as a crucial link among Sri Lanka, India, Bangladesh, Myanmar, and the northern Malay Peninsula. To the west, it is bounded by the southeastern coast of India and the eastern coast of Sri Lanka; to the north, it is adjacent to the deltaic region of the Ganges-Brahmaputra-Meghna River system; and to the east, it extends up to the Andaman-Nicobar ridges (Alam et al., 2015). It undergoes complex ocean circulations driven by monsoonal winds, freshwater inputs, and the Coriolis effect, along with upwelling, freshwater discharge, and tidal movements. The East India Coastal Current (EICC) also significantly influences the Middle Ground (Sarma et al., 2018).

The study area was divided into nine sampling stations to simplify the sampling procedure (fig. 1). Sampling was conducted using plankton nets (length: 1.8 m and internal diameter: 50 cm) of 300 µm mesh size following Gupta et al. (2021) from surface water (0-2m) via Bangladesh Navy ships operating between 100 and 200 m in December 2022. The net was towed for a duration of 15–20 minutes per transect at a consistent speed of approximately 2–3 knots, ensuring optimal surface contact while minimizing turbulence. At each station, three replicate samples were collected to improve statistical robustness and account for spatial heterogeneity. After towing, the net contents were carefully washed down and transferred into pre-cleaned 500-ml amber glass bottles using deionized water. To determine the volume of water filtered during each tow, a mechanical flowmeter (General Oceanics Model 2030R or equivalent) was securely attached to the mouth of the trawl net to enable the normalization of the filtered water volume; particles/m³ were used as a unit of measurement for the abundance of MPs in water. All samples were then transported to the laboratory for further analysis.

The zonation was strategically selected to span the Middle Ground area with coverage across both low and high tidal states. It ensured an assessment of tidal influence on microplastic abundance. Stations were distributed to represent a longitudinal transect approximately 15 to 50 km from the coast.

Table 1: Coordinates and Tidal States of the Sampling Stations

Station No.	Latitude	Longitude	Tidal state
Station 1	21.25505	91.25250	Low tide
Station 2	21.07833	91.24833	Low tide
Station 3	21.05175	91.25283	Low tide
Station 4	21.25012	90.99808	Low tide
Station 5	21.14008	90.97601	High tide
Station 6	21.04121	90.96845	High tide
Station 7	21.25509	90.70033	High tide
Station 8	21.17083	90.66833	High tide
Station 9	21.06783	90.68502	Low tide

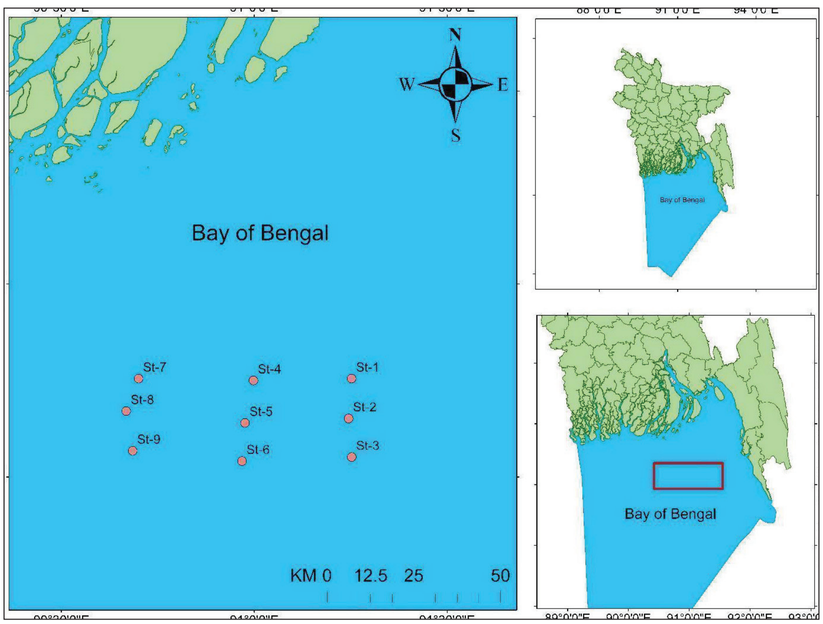

Figure 1: Study Area and Sampling Design in the Middle Ground, BoB. Here 'St' Denotes the Station, and the Red dots are the Position of Each Station. The Map was Produced by Using ArcGIS

Sample Processing

The processing of samples was accomplished following standard procedures, which broadly consisted of three steps: measuring, drying, and digesting (Masura et al., 2015). Samples were processed by first taking a 100 mL aliquot from the sample bottle. This aliquot was then sieved through a 250 µm sieve and rinsed with Deionized Water (DI) three times to ensure all particles were collected. After cleaning, the samples were put in a conical flask and dried overnight at 70°C–80°C. To degrade organic material, the dried sample was subjected to wet peroxide oxidation (WPO). The sample was mixed with 20 mL of 0.05 M $FeSO_4$ solution and 20 mL of 30% H_2O_2, agitated for half an hour and heated to 60°C with stirring at 350 rpm for a whole day while covered with aluminum foil. The solution was diluted with DI after it had cooled for thirty minutes. The risk evaluation included using a condenser and guaranteeing safety because of H_2O_2. For density separation, ~6 g of salt (NaCl) per 20 mL of sample was added to increase the density of the aqueous solution (~5 M NaCl). It was performed via flotation, following the principle that plastic particles vary in density based on polymer type and manufacturing process (Hidalgo-Ruz et al., 2012).

Filtration

Three tools were used for filtration: a 3-liter suction pump system, a Rocker 500 (86.7 kPa) Oil-Free Vacuum Pump filtration system, and nitrate filter paper (Sartorius, German manufactured) with a pore size of 0.45 μm. The vacuum system was configured in compliance with the user manual, emphasizing membrane support to line with cellulose filter paper, and the filtering cup was securely fixed to the glass base using clamps. The vacuum motor was turned on after positioning the hose barb. The pre-diluted solution was added to the filtering cup. Lastly, the filter paper was gingerly lifted.

Visual Identification and Quantification

A stereo microscope (Nikon SMZ1270, Japan) was employed to observe all the particles retained on the filter membrane under 20 to 40 times magnification (Gao et al., 2021). Each particle was zoomed in at 80 times magnification to preliminarily identify and classify particles based on criteria provided by Collignon et al. (2012) and Gies et al. (2018). The particles were categorized into 5 main shapes: fibers, fragments, pellets, foams, and films (Zhao, 2017), and colors: Uniform or brightly colored particles, excluding natural debris with irregular coloration, were identified. Smooth, shiny surfaces without organic structures or cellular features were checked thoroughly. An optical threshold range of 1 mm was set (Hidalgo-Ruz et al., 2012). Where available, reference microplastic samples and control blanks were used to calibrate visual identification. Despite the inherent challenges of visual sorting, this method is widely accepted and yields reliable estimates of microplastic abundance, with an acknowledged error margin of approximately 20% (Jung et al., 2021) . The size range of microplastics was divided into 3 categories: large (2-5 mm), medium (0.5-2 mm), and small (<0.5 mm) for easier comparison (Gao et al., 2021). Due to logistical and resource constraints, advanced spectroscopic confirmation (e.g., FTIR or Raman spectroscopy) was not used in this study. While this limits definitive polymer identification, the employed visual approach is consistent with many preliminary microplastic studies and serves as a foundational baseline.

Quality Control

To account for potential microplastic contamination, a blank control using DI was processed alongside the field samples, following the entire collection, transport, and laboratory separation methodology. Before each use, deionized water was used to clean field sample equipment to decrease background contamination. Investigations were conducted in the lab with cotton lab coats and disposable nitrile gloves to reduce the amount of microplastic present. Following preparation, solutions were immediately covered with aluminum foil after being filtered through a 0.45 μm filter. Glass containers were thoroughly cleaned with deionized water, allowed to dry, and then securely closed. The average number of microplastics in the deionized water was 10 per liter, while the average number in the blank control was 310 per kilogram.

Risk Assessment Indices

The Hakanson, (1980) approach was employed in this study to evaluate the risks associated with microplastics. This method has been used to investigate one crucial risk variable, which is the pollution load index (PLI). A similar methodology has also been applied in other earlier studies.

$$\text{PRF} = \frac{Cs}{Cb} \quad (1)$$

PRF: potential ecological risk factor; Cs-concentration of sample; Cb-background concentration (least concentration in the study)

$$\text{PLI} = \sqrt{PRF} \quad (2)$$

PLI: pollution load index

Statistical Analysis

For each station, three replicate samples were taken, resulting in a total of 27 observations. Prior to inferential analysis, the normality of the microplastic abundance data was assessed using the Shapiro-Wilk test with a significance level of 5% using Python programming. The test indicated that the data did not meet the assumption of normality ($W = 0.922$, $p = 0.043$). Therefore, a non-parametric approach (The Kruskal-Wallis test), the equivalent of one-way ANOVA, was adopted to evaluate whether significant differences in microplastic concentrations existed among the nine stations. This test compared the median ranks across groups without assuming normal distribution, making it suitable for the current data structure.

RESULTS AND DISCUSSIONS

Results

Microplastics were observed at all sampling sites, with a 100% detection rate ranging from 699.91 ± 0.01 microplastics/m^3 to 3532.98 ± 0.01 microplastics/m^3. Amongst those, station 7 and station 2 showed the highest mean abundance with very low variability that indicates highly consistent measurement (Fig. 2), whereas station 6 showed the lowest mean abundance.

The five primary categories of microplastics found in this analysis were fibers, fragments, pellets, foam, and film. Of these types, fibers were the most common, accounting for 54% of the microplastics that have been found; pellets made up 35% of the microplastics found after fibers. Although other shapes like films, foam, and fragments made up lower percentages (2.9%, 2.1%, and 0.3%, respectively), fragments were more common than films (Fig. 2).

Although useful insights were gained from visual characterization, this study did not include polymer-specific identification through spectroscopic analysis (e.g., FTIR or Raman). It limits the precision in source attribution. However, based on the dominance of fibers and pellets, plausible sources include textile wastewater, fishing activities, and personal care products. Fibers, in particular, are often associated with synthetic clothing and fishing gear, whereas pellets could originate from cosmetic products or pre-production plastic nurdles.

Microplastics (MPs) detected in the water samples were categorized based on their color into three primary groups: transparent (39%), which was the most dominant category, white (35%), and multicolored (26%) (Fig. 3). The multicolored MPs included red, yellow, blue, and black particles. Among these, black was the most dominant, whereas yellow was the least dominant.

Three categories were used to classify MP (Fig. 4) in terms of size, large (2-5 mm), medium (0.05-2 mm), and small (<0.5 mm). The majority of MPs fell into the small category (83%), followed by medium (9%) and large (8%)

The comparison among the findings on the abundance of MPs in the middle ground of the BoB and several other studies worldwide (Table 2) will give a better view of the scenario about the level of contamination here.

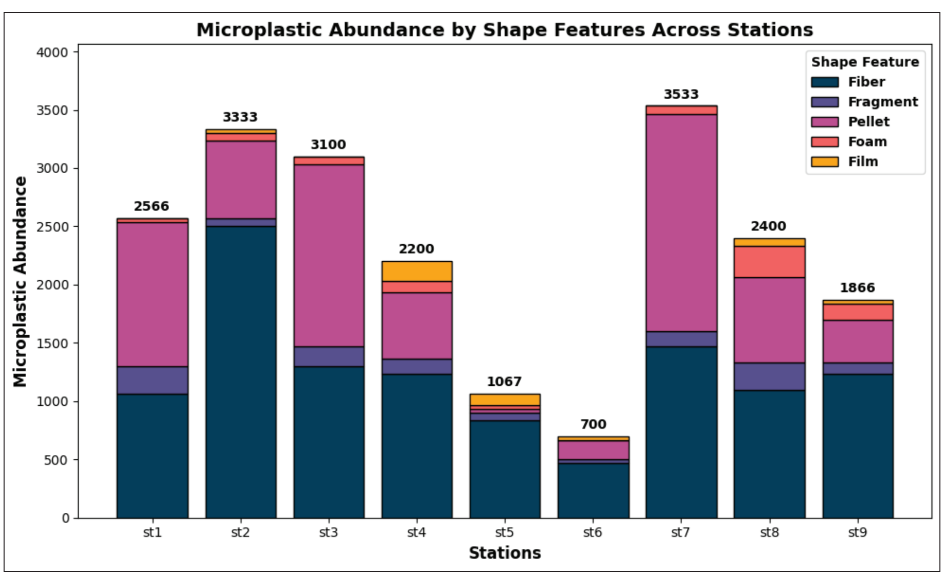

Figure 2: Microplastic Density Across the Stations

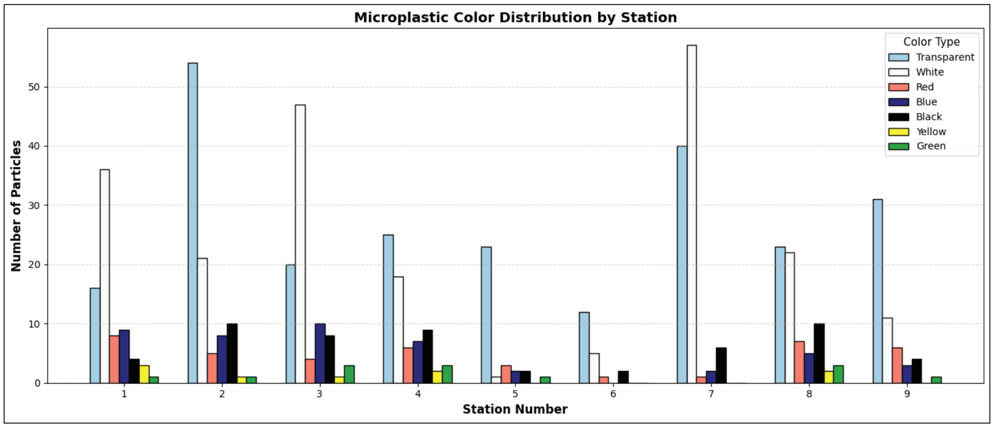

Figure 3: Color Feature of Microplastics in the Water Sample

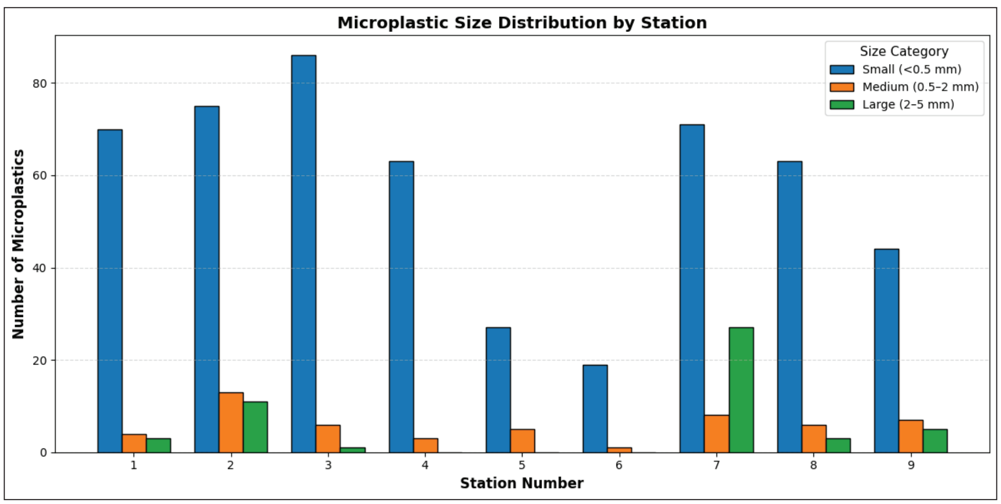

Figure 4: Size Feature of Microplastics in the Water Sample

Table 2: Comparative Table on Microplastic Abundance on Surface Water in Different Locations

Country	Location	Sample Type	Abundance	Unit	Reference
Bangladesh	Middle Ground of the BoB	Surface Water	2307.17 ±707.98	Items/m^3	Present Study
Bangladesh	Moheshkhali channel of Bay of Bengal, Bangladesh	Surface Water	0.1	items/m^3	(Nahian et al., 2023)
Bangladesh	Northern Bay of Bengal, Bangladesh coast	Surface Water	0.021–0.023	items/m^2	(Fatema et al., 2023)
India	Bay of Bengal coastal area, India	upper layer of water	5300±1800	items/m^3	(Patidar et al., 2024)

India	BoB	Surface Water	0.001-0.02	items/m^2	(Eriksen et al., 2019)
	The central east coast of India, BoB	Coastal Water	0.053	items /m^2	(Sambandam et al., 2022)
China	Bohai Sea	Surface Water	0.33 ± 0.34	items/m^3	(Zhang, 2017)
	Jiaozhou Bay	Surface Water	46±28	items/m^3	(Zheng et al., 2019)
Hong Kong	Deep Bay, Tolo Harbor, Tsing Yi, and Victoria Harbor	Surface water	0.51–279.09	items/m^3	(Tsang et al., 2017)
Japan	Japanese Sea (Tokyo Bay, Suruga Bay, Ise Bay, and the Seto Inland Sea)	Surface Water	1.72	items/m^2	(Isobe, 2016)
Philippines	Laguna de Bay	Surface Water	14.29	items/m^3	(Arcadio et al., 2023)
South Africa	South-eastern coastline	Surface Water	257.9 ± 53.36 and 1215 ± 276.7	items/ m^3	(Nel and Froneman, 2015)

The Shapiro-Wilk statistic ($0 \leq w \leq 1$) was the primary indicator of normality, with the Z-score being a standardized value related to the W statistic indicating the deviation from normal distribution. The values indicate a normal distribution with slight deviation. Based on the Shapiro-Wilk test (Supplementary Fig. 1) , the microplastic abundance is not normally distributed ($p<0.05$). The Kruskal-Wallis test (Supplementary Fig. 2) revealed a statistically significant difference in microplastic particle concentrations among the nine sampling stations ($\chi^2 = 25.5$, df = 8, p = 0.0013). This suggests that at least one station's microplastic concentration differs significantly from the others. Rank sums indicated that Station-2 and Station-7 had relatively higher concentrations, while Station-6 and Station-5 had the lowest. These findings highlight spatial variability in microplastic pollution across the study area, which could be influenced by localized environmental factors, human activities, or hydrodynamic conditions.

Discussion

Distribution of Microplastics in the Sampled Location

The datasets suggest a significant range in microplastic contamination levels across different stations in the middle ground of the BoB. Human reach is minimal there, but the microplastic presence is still affected by several factors connected to the broader marine environment and anthropogenic activity. This region is characterized by complex ocean dynamics that might have shaped the abundance pattern. Ocean currents, gyres, and convergence zones (Shetye et al., 1993) might be a dominant factor that transports microplastic to long distances (Eriksen et al., 2014), and stations that undergo these dynamics might experience the highest microplastic abundance.

The datasets suggest a significant range in microplastic contamination across different stations. For the purposes of this study, the pollution levels were classified into three categories relative to the mean abundance (2307 ± 2.9) of all stations in our survey. Amongst those, station 7 (3532.99 ± 0.01) showed the highest mean abundance whereas station 2 (3333.04 ± 0.01) and station 3 (3099.67 ± 0.03), demonstrated a high abundance with very low variability that indicates highly consistent measurement (Fig. 2); these might have been influenced by ocean currents that carry debris and pollutants from shipping lanes and nearby fishing grounds and also possibly affected by currents carrying microplastics from coastal regions or convergence zones. However, Stations 1, and 8 showed moderately polluted status (2566.42 ± 0.00, and 2399.76 ± 0.03) with low deviations suggesting reliable measures. Station 4 and Station 9 had lower mean abundance with low variability (2199.78 ± 0.03 and 1866.47 ± 0.03), while Stations 6 had the lowest mean abundance (699.91 ± 0.01) however station 5 demonstrated a lower abundance with very low deviation (1066.59 ± 0.01). These areas might be further from major current paths or less influenced by upstream sources, resulting in lower contamination levels. This observed spatial pattern is consistent with previous studies that demonstrate the role of ocean currents in creating microplastic accumulation zones and areas of lower concentration based on hydrodynamic transport pathways (Eriksen et al., 2014; Strafella et al., 2021).

Shape of Microplastics

Plastics from different sources show different shapes when exposed to weathering conditions; hence, it is possible to link the origin and sources of plastic based on its morphology. According to (Borges-Ramírez et al., 2020), most fibers found in aquatic systems have been connected to fishing and laundry, highlighting the variety of sources that contribute to the pollution caused by microplastics. UV-light-protecting clothes made of synthetic textiles can release a high number of microfibers (Piñon-Colin et al., 2018). Because of the geographical position of the BoB and its significance for shipping routes, marine activities—including shipping and maritime transport, particularly cargo ships and fishing vessels—often use synthetic textiles in their operations, which releases microfibers into the marine environment. Several nations bordering the BoB rely heavily on the textile sector, and releasing untreated wastewater containing synthetic fibers into adjacent water bodies can worsen the problem of microplastic pollution.

Pellets made up 35% of the microplastics found after fibers. Pellets were the main sources of microplastic pollution, frequently coming from cosmetic and laundry goods (Barasarathi, 2014). Microbeads are microscopic plastic particles used as abrasives or as exfoliants in cosmetics and personal hygiene products. These microbeads wind up in oceans and gradually degrade into smaller pieces of plastic, such as pellets.

Although other shapes like films, foam, and fragments made up lower percentages (2.9%, 2.1%, and 0.3%, respectively), fragments were more common than films. The degradation process is impacted by various factors, including extended exposure to UV light, heat, and well-aerated environments, which are responsible for its prevalence (Zhang, 2017). Product degradation, such as single-use plastics, plastic bags, and waste from tourism, is the primary source of the film (Robin et al., 2020; Sruthy & Ramasamy, 2017). The films are probably made of agriculture and plastic bags, underscoring the variety of sources of microplastic contamination (Wang et al., 2019).

Color of Microplastics

It's a serious concern, as the color of MPs can attract organisms, especially when the particles resemble the color of their food (Bajt, 2021). Colored MPs are commonly derived from clothing materials, packaging, and various commercial applications (Xu et al., 2018). The diverse colors of MPs indicate their varied origins in the environment (Bimali Koongolla et al., 2018; Lin et al., 2018). The color can provide details on the absorption capacity of heavy metals and microplastic organic pollutants. Dark-colored MPs, including blue and black, are more likely to absorb heavy metals, (Huang et al., 2020). Frias et al., (2010) reported that white MPs absorbed fewer persistent organic contaminants than MPs of other colors.

Size of Microplastics

Given the predominance of their small size, they are more vulnerable to disruption by hydrodynamic processes, which can explain how they are transmitted to the water layer above by resuspension. Additionally, photo-oxidation has a direct impact on it (Zhang, 2017).

This result is similar to the patterns reported by (Browne et al., 2010; Eriksen et al., 2019). In the central coast of India, the BoB, small MPs (<0.5 mm), account for >50% of the whole and are dominant in the offshore region (10 km) (Sambandam et al., 2022). The reason for being small is the most abundant due to the long transport from their sources However, it is more alarming as the reduced size of microplastic makes it easier for aquatic organisms to take in (Issac and Kandasubramanian, 2021).

Risk Assessment of MP Pollution

The ecological risk posed by microplastics in the study area has been assessed using two quantitative indices: PRF (potential ecological risk factor) and PLI (pollution load index) (Table 3). These indices help assess both site-specific contamination levels and overall pollution status across the region. The level of risk associated was explained based on the scores and calculated outcomes.

Table 3: Risk Evaluation Indices of MP in the Study Area

Station No.	PRF	PLI
1	3.66	1.91
2	4.76	2.18
3	4.43	2.10
4	3.14	1.77
5	1.52	1.23
6	1.00	1.00
7	5.04	2.24
8	3.43	1.85
9	2.67	1.63

The PRF values (Eqn. (1)) indicated a minor risk, as they were below 150. Moreover, PLI (Eqn. (2)) ranged between 1.00 and 2.24, placing the entire region in the minor risk category (I). The classification of Potential Ecological Risk Factor (PRF) values in this study follows Hakanson's ecological risk index framework (Hakanson, 1980), where values less than 40 are considered to indicate low or minor risk, 40–80 indicate moderate risk, 80–160 considerable risk, 160–320 high risk, and values ≥320 very high risk.

A few studies have been known to conduct risk assessments in marine environments (Rakib et al., 2022; Ranjani et al., 2021; Ranjani et al., 2022). Hence, this research findings provided preliminary information on MP pollution in the study area and quantitative estimates of the ecological risk level, which would help future research in this field.

Possible Implications of Microplastics on Fisheries and Human Health

The middle ground of the BoB is an important fishing ground that supports fisheries, livelihoods, and the economy. However, microplastics may cause physical injuries, blockage, rupture, abrasion, and lesions; false satiation sensation (the absence of hunger); and starvation in organisms used as seafood, especially ingesting microplastics, which can reduce fish growth and food consumption, leading to a reduced yield of fish biomass threatening the sustainability of fisheries (Kibria, 2023). Seafood supplies about 60% of animal protein in Bangladesh (Shamsuzzaman, 2020). Therefore, there is the possibility of transferring microplastics and microplastic-associated chemicals (DDT, heavy metals) to human consumers via the consumption of microplastic-contaminated seafood. The transfer of MPs to humans can be avoided if the stomachs and intestines of fish are removed before consumption since most MPs accumulate in the gastrointestinal tract (Kibria, 2023).

CONCLUSIONS

This study provided the first assessment of microplastics in the water samples of the middle ground of the BoB. It investigated the characterization of microplastic occurrence and distribution patterns in surface water samples collected from nine locations. The abundance of microplastics varied among the sampled locations, with higher abundance observed at the northwestern part of the middle ground. The analysis identified microplastic particles exhibiting a range of shapes, colors, and sizes. Fibers and pellets were the most abundant shapes, with fibers being the dominant type, followed by pellets, foam, fragments and film. Transparent microplastics were persistent in terms of coloration. Microplastic pollution in the BoB might be sourced from tourism, fishing, and marine transportation, while environmental factors and global currents contribute to its spread. The study highlights the urgent need for further research and effective management strategies to mitigate the impact of microplastic pollution on marine ecosystems. The study revealed that the BoB faces a threat from microplastic pollution; the PLI and PRI scores place the region in the category of minor risk zone, emphasizing the need for effective mitigation strategies and conservation efforts. Although this study emphasizes the Middle Ground of the Bay of Bengal as a significant fishing ground, it focuses solely on microplastic presence in the water column. While sediment and biota (including fish species) are also critical for a comprehensive assessment of the environmental and ecological impact of microplastics, this study serves as a foundational baseline investigation. The logistical and methodological constraints of sampling offshore sediments and marine organisms from such dynamic environments limited the scope to water-based assessment. Future studies should incorporate sediment and biotic matrices to offer a more holistic understanding of microplastic pollution in this ecologically and economically vital region.

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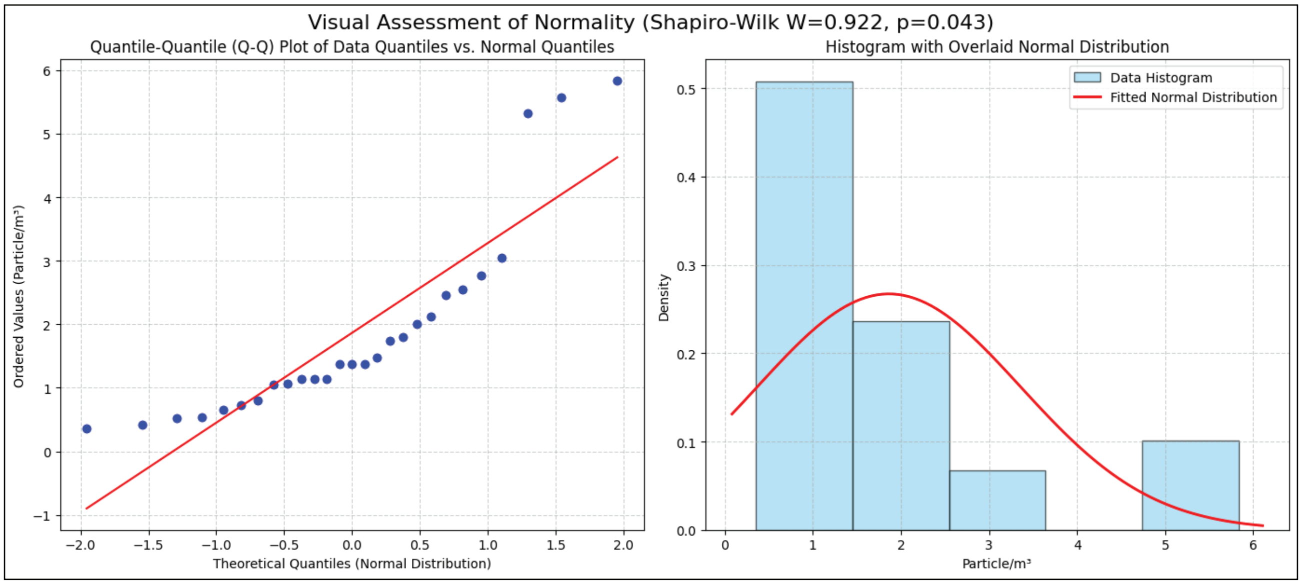
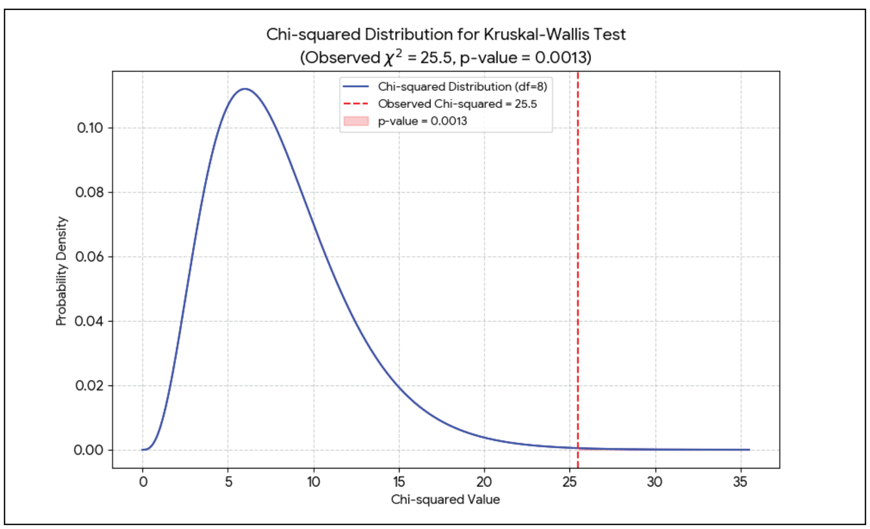
Supplementary Materials



Supplementary Figure 1: Visual Assessment of Normality Test



Supplementary Figure 2: Graphical Display of Kruskal-Walli's Test Statistics, Focusing on the Chi-Squared Distribution and p-value