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Monitoring Microplastics in Coastal Sediments of Eastern Mindanao Island, Philippines

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ABSTRACT: Microplastic contamination in coastal sediments represents a growing environmental concern, particularly in tropical regions where intensive coastal development and diverse anthropogenic activities contribute to plastic accumulation. However, spatially resolved information on microplastic abundance, morphology, and polymer composition remains limited in the coastal environments of Eastern Mindanao, Philippines. This study assessed the spatial distribution and characteristics of sediment-associated microplastics across five coastal locations representing fishing communities, estuarine environments, industrial-port activities, tourism, and aquaculture. Surface sediment samples were processed using density separation and chemical digestion, followed by microscopic characterisation and Fourier-transform infrared spectroscopy (FTIR) for polymer identification. Microplastics were detected at all sampling locations, with concentrations ranging from 76 ± 9 to 187 ± 22 particles/kg dry sediment. The highest concentration was observed in the industrial-port area, whereas the lowest occurred at the less populated tourist beach, indicating spatial heterogeneity in microplastic accumulation across different coastal settings. Fragments and fibers predominated across the sampling locations, suggesting contributions from the fragmentation of larger plastic debris and potentially fiber-releasing activities. FTIR analysis identified polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), and polyethylene terephthalate (PET), with PE and PP collectively accounting for more than 60% of the identified particles. Variations in microplastic abundance, morphology, color, and polymer composition indicated potential relationships with surrounding land-use characteristics, although specific pollution sources could not be conclusively established. The principal contribution of this study is the integrated characterisation of microplastic abundance, particle morphology, and polymer composition across contrasting coastal land-use settings in an understudied tropical island region. The findings establish a preliminary baseline for sediment microplastic contamination in Eastern Mindanao and provide evidence to inform targeted pollution monitoring, source investigations, and coastal waste-management strategies.

KEYWORDS: Coastal sediments; Eastern Mindanao; FTIR spectroscopy; land-use characteristics; microplastic contamination; polymer composition; tropical coastal ecosystems

1. Introduction

Plastic pollution has become one of the most widespread environmental challenges affecting marine and coastal ecosystems, driven by increasing plastic production, inadequate waste management, and the continuous release of plastic debris into aquatic environments [1]. Among these contaminants, microplastics, commonly defined as plastic particles smaller than 5 mm, have attracted considerable attention because of their environmental persistence, widespread distribution, and potential ecological effects on marine organisms [1, 2]. Their small size facilitates ingestion by organisms across different trophic levels, while their physical and chemical characteristics influence their transport, accumulation, and interactions with surrounding environmental matrices. Microplastics enter coastal waters through multiple pathways, including the fragmentation of larger plastic debris, wastewater discharge, synthetic textile fibers, riverine transport, fishing activities, and atmospheric deposition [1, 3]. These diverse sources and transport mechanisms complicate efforts to identify pollution origins and develop effective mitigation strategies.

Coastal sediments play a critical role in the environmental fate of microplastics by functioning as accumulation zones for particles transported from terrestrial and marine sources. Depending on particle density, morphology, hydrodynamic conditions, and sediment characteristics, microplastics may settle, become incorporated into sedimentary deposits, or undergo repeated resuspension and redistribution [4, 5]. Consequently, sediment analysis provides valuable information on the spatial distribution, composition, and potential accumulation of microplastic contamination. Previous investigations have documented substantial variations in sediment microplastic abundance across estuaries, fishing harbors, industrial coastlines, aquaculture areas, and recreational beaches [6, 7]. These differences are frequently associated with coastal land use, population density, waste disposal practices, fishing intensity, and local hydrodynamic processes. Furthermore, particle morphology and polymer composition can provide complementary information about potential contamination pathways, although these characteristics alone cannot conclusively identify specific pollution sources [7, 8].

The Philippines is particularly vulnerable to coastal plastic contamination because of its extensive coastline, high dependence on marine resources, and persistent challenges in solid waste collection and management. Plastic debris originating from residential settlements, commercial activities, fishing operations, and coastal industries can enter marine environments through direct disposal, surface runoff, and river discharge. Previous investigations have identified microplastics in Philippine coastal sediments, aquatic organisms, and commercially available salt, demonstrating their distribution across multiple environmental and food related matrices [9–11]. These findings highlight the importance of systematic environmental monitoring, particularly in coastal communities where fisheries, aquaculture, and tourism contribute substantially to local livelihoods. However, the spatial coverage of existing investigations remains uneven, with relatively greater research attention directed toward selected coastal environments in Luzon and the Visayas than toward several areas of Mindanao [10, 12].

Despite increasing research on microplastic contamination in Philippine coastal environments, important knowledge gaps remain concerning the spatial variability of sediment microplastics across contrasting coastal land uses in Eastern Mindanao. Existing studies have generally focused on documenting microplastic occurrence and abundance, while integrated

assessments combining particle concentration, morphology, color, and polymer composition across different anthropogenic settings remain limited in this region [10, 12]. This limitation restricts understanding of whether coastal environments influenced by fishing, port operations, tourism, estuarine processes, and aquaculture exhibit distinguishable contamination characteristics. Moreover, differences in sampling procedures, particle identification methods, and reporting units can complicate comparisons between locations and reduce the usefulness of available data for environmental monitoring and management. A consistent assessment using microplastic concentrations expressed as particles/kg dry sediment, supported by microscopic characterization and spectroscopic polymer identification, is therefore needed to establish a comparable regional baseline.

Eastern Mindanao, particularly the coastal environments of Surigao del Sur, provides a relevant setting for investigating these issues because it contains coastal communities with diverse land use and anthropogenic activities. Fishing villages, estuarine environments, industrial and port facilities, recreational beaches, and aquaculture settlements represent contrasting potential sources and pathways of plastic contamination. Differences in human activity, waste generation, shoreline characteristics, and sedimentary conditions may influence the abundance and composition of microplastics accumulated in these environments [13, 14]. Examining these coastal settings within the same regional investigation offers an opportunity to identify spatial contamination patterns and evaluate their possible associations with surrounding land use. Importantly, such comparisons must account for the potential influence of hydrodynamic transport and background contamination, since microplastics detected at a particular location may originate from both nearby activities and more distant sources.

Therefore, this study aimed to assess the abundance, morphological characteristics, and polymer composition of microplastics in surface sediments collected from five coastal locations representing different land use settings in Eastern Mindanao, Philippines. Specifically, the objectives were to (i) quantify and compare microplastic concentrations across sampling locations, expressed as particles/kg dry sediment; (ii) characterize the distribution of particle shapes and colors to identify spatial differences in microplastic characteristics; and (iii) determine the dominant polymer types using Fourier transform infrared spectroscopy (FTIR). By integrating quantitative abundance measurements with morphological and polymer characterization, this study provides a regional baseline for evaluating sediment microplastic contamination across contrasting coastal environments. The principal contribution lies in identifying spatial differences in microplastic characteristics in relation to coastal land use within an understudied tropical region, providing evidence to support future pollution source investigations, standardized environmental monitoring, and targeted coastal waste management strategies.

2. Materials and Methods

2.1. Study Area and Sampling Sites.

This study was conducted along five coastal sites situated within Surigao del Sur province on the eastern seaboard of Mindanao Island, Philippines. The five sites were purposively selected to capture a gradient of coastal land-use contexts: Site 1 (Lianga Bay), a fishing village near a river mouth; Site 2 (Hinatuan), a mangrove-fringed estuary; Site 3 (Bislig City), an area subject to port and industrial activity; Site 4 (Cagwait), a low-population tourist beach; and Site 5

(Cantilan), a coastal settlement supporting aquaculture operations. Geographic coordinates and substrate characteristics for each site are summarized in Table 1.

Table 1. Characteristics of the Five Coastal Sampling Sites in Eastern Mindanao Island, Philippines

Site	Location	Coordinates	Substrate Type	Land-Use Context
S1	Lianga Bay, Surigao del Sur	8.6325° N, 126.0958° E	Fine sand	Fishing village, river mouth
S2	Hinatuan, Surigao del Sur	8.3667° N, 126.3333° E	Mixed sand-mud	Mangrove-fringed estuary
S3	Bislig City, Surigao del Sur	8.2150° N, 126.3197° E	Coarse sand	Port and industrial activity
S4	Cagwait, Surigao del Sur	8.6833° N, 126.2667° E	Fine sand	Tourist beach, low population
S5	Cantilan, Surigao del Sur	9.3333° N, 125.9500° E	Mixed sand-mud	Coastal settlement, aquaculture

2.2. Sediment Sample Collection.

At each of the five sites, surface sediment samples (top 5 cm) were collected from the intertidal zone using a stainless-steel scoop, following standardized protocols adapted from prior microplastic sediment monitoring studies [15, 16]. Triplicate samples were collected at each site at intervals of approximately 25 m along a 100 m transect parallel to the shoreline, yielding a total of fifteen discrete samples across the study area. Each sample (approximately 500 g wet weight) was placed in a pre-cleaned aluminum container, sealed, and transported to the laboratory under cool, dark conditions to minimize photodegradation and cross-contamination. Field blanks consisting of pre-cleaned sand were processed alongside each sampling event to monitor for airborne or procedural contamination.

2.3. Laboratory Extraction and Polymer Identification.

In the laboratory, sediment samples were oven-dried at 60°C for 48 hours and homogenized prior to density separation. Microplastic extraction followed a saturated sodium chloride (NaCl) flotation protocol, in which approximately 100 g of dried sediment was mixed with saturated NaCl solution (density ≈ 1.2 g cm^{-3}), agitated, and allowed to settle for 24 hours to permit buoyant plastic particles to float to the surface [15, 16]. The supernatant was filtered through 0.45 μm cellulose nitrate filter paper, and organic matter was digested using 30% hydrogen peroxide (H_2O_2) at 60°C for 24 hours to remove biological residues that could obscure visual identification. Particles retained on the filter paper were examined under a stereomicroscope at 10–40× magnification, and suspected microplastic items were classified by morphology (fragment, fiber, film, foam, or pellet) and color, following established visual identification criteria [5]. A representative subsample (approximately 20% of all visually identified particles from Sites 1, 3, and 5) was further analyzed using Fourier-transform infrared spectroscopy (FTIR) in attenuated total reflectance (ATR) mode to confirm polymer identity, with spectral matches accepted at a minimum library match quality of 70%, consistent with quality assurance recommendations for microplastic polymer identification [15, 17]. Quantification was expressed as the number of microplastic items per kilogram of dry sediment (items/kg), and abundance data were tested for between-site differences using one-way analysis of variance (ANOVA) with Tukey's post-hoc test at a significance threshold of $p < 0.05$.

3. Results and Discussion

3.1. Spatial Variation in Microplastic Abundance.

Microplastics were detected in sediment samples from all five coastal sampling sites in Eastern Mindanao, Philippines, indicating that contamination was widespread across the investigated coastline. However, the abundance varied considerably among locations, suggesting spatial differences in microplastic accumulation associated with local environmental conditions and anthropogenic activities. Table 2 presents the descriptive statistics of microplastic abundance, including the mean, standard deviation, minimum and maximum concentrations, and dominant particle colours at each sampling site. The highest mean abundance was recorded at Site 3 (Bislig), with 187 ± 22 items/kg, ranging from 159 to 214 items/kg. This was followed by Site 1 (Lianga Bay), with 142 ± 18 items/kg, and Site 5 (Cantilan), with 121 ± 15 items/kg. Lower concentrations were observed at Site 2 (Hinatuan), with 98 ± 12 items/kg, while Site 4 (Cagwait) recorded the lowest abundance at 76 ± 9 items/kg. The mean concentration at Bislig was approximately 2.46 times higher than that at Cagwait, demonstrating substantial spatial variation in sediment contamination. The standard deviations also differed among locations, with Bislig exhibiting the greatest absolute variability and Cagwait the lowest. Regarding particle colour, transparent or white microplastics dominated at Lianga Bay and Bislig, blue particles were predominant at Hinatuan, white particles at Cagwait, and blue or black particles at Cantilan. These differences suggest variations in the characteristics of microplastic contamination across the sampling sites, although particle colour alone cannot establish specific pollution sources

Table 2. Summary Statistics of Microplastic Abundance by Sampling Site.

Site	Mean ± SD (items/kg)	Min (items/kg)	Max (items/kg)	Dominant Color
S1 – Lianga Bay	142 ± 18	118	168	Transparent/White
S2 – Hinatuan	98 ± 12	82	115	Blue
S3 – Bislig	187 ± 22	159	214	Transparent/White
S4 – Cagwait	76 ± 9	64	89	White
S5 – Cantilan	121 ± 15	101	142	Blue/Black

Figure 1 illustrates the spatial differences in mean microplastic abundance and their associated standard deviations across the five sampling sites. The distribution shows a distinct peak at Bislig, followed by Lianga Bay and Cantilan, whereas Hinatuan and Cagwait exhibited comparatively lower concentrations. One-way ANOVA indicated statistically significant differences in microplastic abundance among the sampling sites ($p < 0.05$). Tukey's post hoc comparisons further indicated that Bislig differed significantly from all other sites, while Cagwait had significantly lower concentrations than Lianga Bay, Bislig, and Cantilan. These findings demonstrate that microplastic contamination was not uniformly distributed across the investigated coastal environments. The elevated microplastic abundance at Bislig may be associated with its proximity to port operations and industrial infrastructure, where shipping activities, industrial discharges, and other anthropogenic inputs can contribute to the introduction and accumulation of plastic particles in coastal sediments. Similar relationships between intensive coastal activities and elevated microplastic contamination have been reported in previous studies [18,19]. Nevertheless, the present findings establish spatial

differences in sediment contamination rather than directly identifying individual pollution sources.

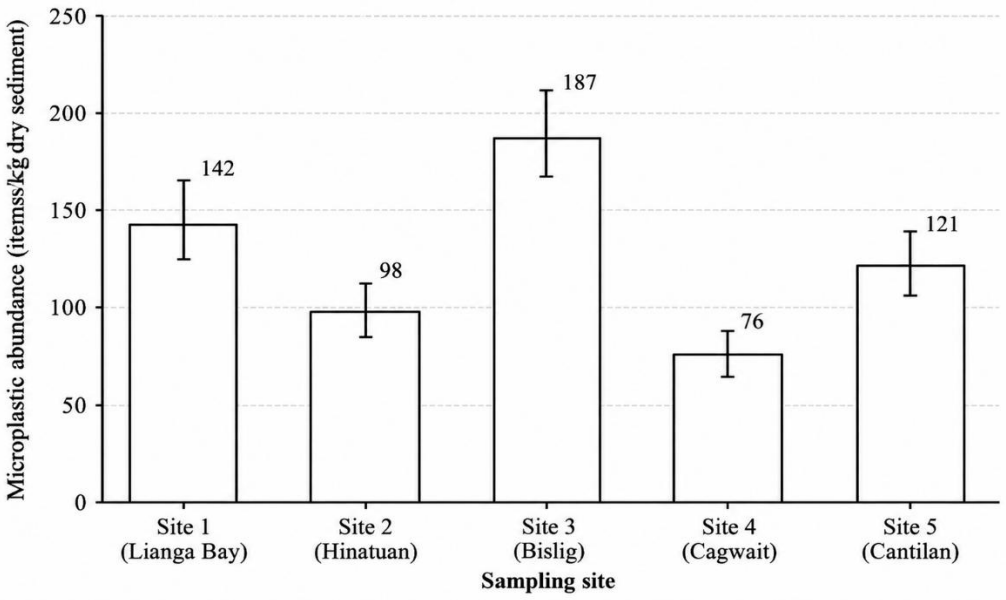


Figure 1. Microplastic Abundance Across Five Coastal Sampling Sites, Eastern Mindanao Island, Philippines.

In contrast, the comparatively low abundance observed at Cagwait may reflect its relatively limited industrial activity, lower population density, and absence of major nearby riverine inputs. This interpretation is consistent with previous findings indicating that the intensity of local land-based pollution sources can influence microplastic accumulation in coastal sediments [1, 19]. However, hydrodynamic conditions, sediment transport, and local deposition processes may also contribute to the observed differences. The intermediate concentrations recorded at Lianga Bay, Hinatuan, and Cantilan suggest that microplastic contamination is not restricted to heavily industrialised coastal areas. Fishing operations, aquaculture activities, estuarine inputs, and the deterioration of plastic fishing equipment may contribute to the introduction of microplastics into these environments [18, 20]. Such activities can generate dispersed pollution inputs that accumulate in sediments over time, even where major industrial point sources are absent.

3.2. Morphological and Color Composition of Microplastics.

The morphological composition of microplastics varied across the five coastal sampling sites, although fragments and fibers consistently represented the dominant particle types (Figure 2). Together, these two morphotypes accounted for approximately 59–66% of the recovered particles, indicating that irregular plastic fragments and elongated synthetic fibers were the principal forms of microplastic contamination in the investigated sediments. In comparison, films, foams, and pellets contributed smaller proportions at all locations. This distribution suggests that secondary microplastics, potentially generated through the physical fragmentation and deterioration of larger plastic materials, constitute an important component of coastal sediment contamination in Eastern Mindanao. The predominance of fragments and fibers is consistent with previous studies reporting similar morphological distributions in coastal environments affected by fishing activities, domestic waste discharge, and other land-based pollution sources [7, 12, 18].

As illustrated in Figure 2, fragments exhibited the highest relative abundance at Site 3 (Bislig), accounting for approximately 42% of the recovered microplastics, followed by Site 1 (Lianga Bay), where fragments represented approximately 38%. The lowest fragment proportion was observed at Site 4 (Cagwait), at approximately 29%. The comparatively high proportion of fragments at Bislig may reflect the influence of nearby port operations, industrial activities, and coastal waste inputs. Larger plastic materials introduced through these activities can undergo progressive fragmentation due to ultraviolet radiation, mechanical abrasion, wave action, and other environmental weathering processes. Over time, these processes may produce smaller, irregularly shaped particles that become incorporated into coastal sediments. Nevertheless, the present morphological observations do not establish the precise origin of the fragments, and these potential source pathways should be interpreted as plausible explanations rather than confirmed relationships.

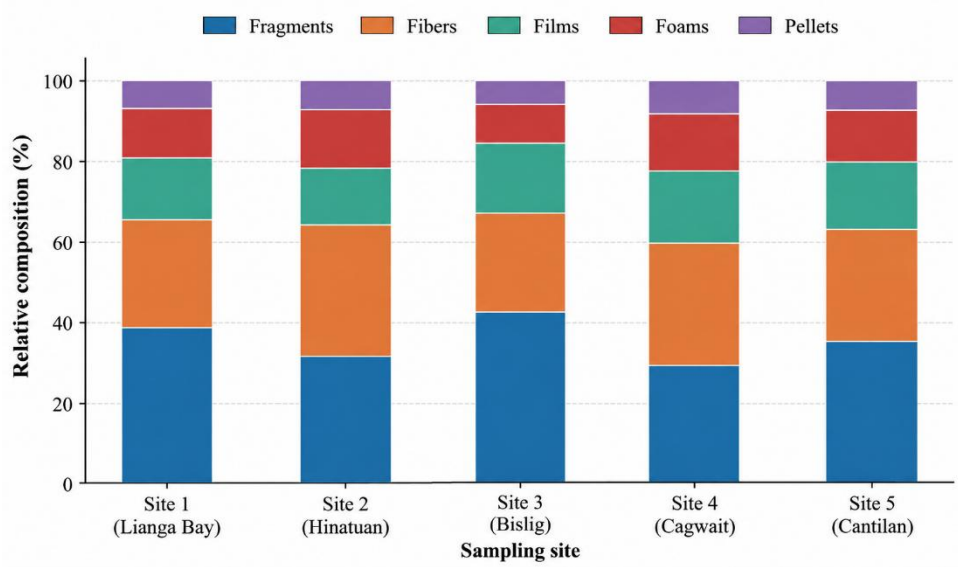


Figure 2. Relative Composition of Microplastic Morphotypes by Sampling Site.

Fibers were also widely distributed across the investigated coastline, representing approximately 24–33% of the recovered particles (Figure 2). The highest relative proportion occurred at Site 2 (Hinatuan), where fibers accounted for approximately 33%, while lower proportions were recorded at sites where fragments were more dominant. This pattern may be associated with the environmental characteristics of Hinatuan, particularly its estuarine setting and the presence of mangrove-associated coastal environments. Estuarine circulation, tidal exchange, and relatively sheltered depositional areas can influence the transport and retention of suspended particles, including elongated fibers. In addition, fishing nets, synthetic ropes, aquaculture materials, and textile-derived wastewater represent possible sources of fibrous microplastics in coastal waters [19, 21]. The flexible and elongated structure of fibers may also influence their transport, entanglement with organic matter, and eventual deposition within sedimentary environments. However, these mechanisms were not directly evaluated in the present study.

The relative proportions of fragments and fibers also reveal differences in the morphological characteristics of contamination among sampling sites. Bislig exhibited a fragment-dominated profile, whereas Hinatuan and Cagwait showed comparatively greater contributions from fibers. These differences may reflect variations in local plastic consumption,

waste disposal practices, fishing activities, and environmental transport processes. Importantly, the relative abundance of a particular morphotype does not necessarily indicate a higher absolute concentration of that particle type. For example, although Cagwait exhibited a relatively substantial proportion of fibers, its overall microplastic abundance was the lowest among the five sites, as shown previously in Table 2. Consequently, the morphological percentages presented in Figure 2 should be interpreted alongside the site-specific abundance data to obtain a more complete understanding of contamination patterns.

Films constituted a smaller but consistently identifiable component of the recovered microplastics, contributing approximately 14–19% across the sampling sites. Their occurrence may be associated with the degradation of thin plastic materials, including packaging films, plastic bags, and agricultural or commercial plastic sheets that enter coastal environments through improper waste disposal and surface runoff. Because films are generally thin and flexible, their environmental behaviour may differ from that of thicker fragments. Depending on polymer density, biofouling, and local hydrodynamic conditions, film particles may remain suspended, undergo further fragmentation, or accumulate in sedimentary depositional zones. The relatively consistent occurrence of films across the five locations suggests that thin plastic materials may contribute to microplastic contamination beyond areas directly influenced by major industrial activities.

Foams and pellets represented the least abundant morphotypes, although both were detected at all sampling sites. Foam particles may originate from deteriorating expanded plastic products used in packaging, fishing floats, and other coastal applications, whereas pellets may be associated with industrial plastic materials or other rounded plastic particles. Their comparatively low proportions suggest that these morphotypes contributed less to the recovered sediment microplastic assemblage than fragments and fibers. However, the occurrence of pellets should not automatically be interpreted as evidence of industrial resin pellet discharge, because morphological classification alone cannot establish their manufacturing origin. Similarly, the presence of foam particles indicates the occurrence of this material type but does not identify a specific source.

In addition to morphological variation, differences in particle colour were observed among the sampling locations. As indicated by the site-level characteristics reported in Table 2, transparent or white particles were dominant at Sites 1 (Lianga Bay) and 3 (Bislig), while white particles were most common at Site 4 (Cagwait). In contrast, blue particles predominated at Site 2 (Hinatuan), and blue and black particles were characteristic of Site 5 (Cantilan). These spatial differences may reflect variations in the types of plastic materials entering each coastal environment. Transparent and white particles may be associated with packaging materials, plastic containers, and weathered consumer products, whereas blue and black particles may originate from synthetic ropes, fishing nets, aquaculture equipment, or other commonly used plastic materials [19, 20].

The prevalence of blue particles at Cantilan is particularly relevant given the potential contribution of fishing and aquaculture activities to coastal plastic pollution. Blue-pigmented synthetic ropes and netting are commonly used in marine operations, and their deterioration can generate microplastic fragments and fibers that may subsequently accumulate in sediments [19, 20]. Similarly, the predominance of blue particles at Hinatuan may reflect contributions from fishing-related materials or other local plastic waste sources. Nevertheless, colour

characteristics cannot independently confirm the origin of these particles, because similar colours occur in multiple plastic products and industrial applications.

3.3. Polymer Identification and Implications for Pollution Sources.

Fourier-transform infrared (FTIR) spectroscopy was employed to identify the polymer composition of selected microplastic particles recovered from Sites 1 (Lianga Bay), 3 (Bislig), and 5 (Cantilan). The analysis identified five polymer types: polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), and polyethylene terephthalate (PET). As presented in Table 3, PE was the most abundant polymer, with an overall mean contribution of 34.5%, followed by PP (26.3%), PS (15.2%), PVC (12.8%), and PET (11.2%). Together, PE and PP accounted for 60.8% of the identified polymers, indicating that polyolefin-based plastics constituted the predominant component of the FTIR-characterised microplastic particles. This finding is consistent with the widespread production and use of PE and PP in packaging materials, fishing equipment, household products, and disposable consumer items. Similar polymer distributions have been reported in previous investigations of coastal sediments affected by urban development, fisheries activities, and land-based plastic waste inputs [9,10,19,22].

Table 3. Polymer Composition of Microplastics Identified via FTIR at Selected Sampling Sites.

Polymer Type	S1 (%)	S3 (%)	S5 (%)	Overall Mean (%)
Polyethylene (PE)	34.2	37.6	31.8	34.5
Polypropylene (PP)	26.1	24.3	28.4	26.3
Polystyrene (PS)	15.4	16.2	13.9	15.2
Polyvinyl chloride (PVC)	12.8	11.5	14.1	12.8
Polyethylene terephthalate (PET)	11.5	10.4	11.8	11.2

The distribution of polymers differed moderately among the three analysed sites (Table 3). Bislig exhibited the highest PE proportion (37.6%), compared with Lianga Bay (34.2%) and Cantilan (31.8%). This finding is particularly relevant because Bislig also recorded the highest microplastic abundance, as reported in Table 2. The elevated PE contribution may reflect the influence of packaging waste, port operations, industrial activities, and other coastal anthropogenic inputs. PE is widely used in plastic bags, containers, and flexible packaging, which can undergo fragmentation through prolonged exposure to sunlight, mechanical abrasion, and wave action. However, the observed polymer composition alone cannot establish the specific sources of contamination.

PP was the second most abundant polymer, with its highest contribution recorded at Cantilan (28.4%). This may be associated with fishing and aquaculture activities, where polypropylene-based ropes, nets, and woven materials are commonly used. The deterioration of these materials can generate microplastic fragments and fibers that subsequently enter coastal sediments [19,20]. The relatively consistent occurrence of PP across all three sites suggests that both fisheries-related activities and general consumer plastic waste may contribute to contamination.

PS accounted for 13.9–16.2% of the identified polymers, with the highest proportion observed at Bislig. Its presence may be associated with disposable food containers, packaging materials, and expanded polystyrene products used in fisheries and seafood transportation. Meanwhile, PVC showed its highest contribution at Cantilan (14.1%), potentially reflecting

inputs from construction materials, plastic pipes, and coastal aquaculture infrastructure. Unlike PE and PP, PVC generally has a higher density than seawater, which may influence its transport and deposition in coastal sediments. Nevertheless, local hydrodynamic conditions, particle characteristics, and sediment resuspension also affect polymer accumulation [19,20].

PET represented the lowest overall proportion (11.2%), although its occurrence was relatively consistent across the three sites, ranging from 10.4% at Bislig to 11.8% at Cantilan. PET is commonly associated with beverage bottles, food packaging, and synthetic textiles. Its presence at all analysed sites suggests that widely distributed consumer plastic waste may contribute to coastal contamination regardless of differences in local land use [21,22].

The polymer composition also complements the morphological findings presented in Figure 2. The predominance of fragments and fibers is consistent with the occurrence of polymers commonly used in packaging, fishing gear, and synthetic materials. However, direct relationships between individual morphotypes and polymer types cannot be established without particle-specific confirmation. Furthermore, because FTIR analysis was limited to selected particles from three sites, the reported percentages should be interpreted as representative of the analysed subsamples rather than the entire microplastic population across all five locations.

4. Conclusion

This study confirmed the widespread occurrence of microplastics in coastal sediments across Eastern Mindanao Island, Philippines, demonstrating that contamination is present in a variety of coastal environments regardless of land-use type. Microplastics were detected at all sampling sites, indicating that plastic pollution has become a pervasive component of the region's coastal ecosystem. Significant differences in abundance among sites suggest that local anthropogenic activities strongly influence contamination levels, with the highest concentrations observed near port and industrial areas and lower concentrations recorded at less developed coastal locations. Fragments and fibers were the dominant microplastic morphotypes, reflecting the degradation of larger plastic items and the contribution of fishing, aquaculture, and domestic waste sources. Polymer analysis further revealed the predominance of polyethylene and polypropylene, materials commonly associated with packaging products, fishing gear, and consumer plastics. The presence of additional polymers such as polystyrene, polyvinyl chloride, and polyethylene terephthalate highlights the diverse origins of plastic contamination entering coastal environments. Overall, the results provide an important baseline dataset for a previously understudied region of the Philippines and contribute to the growing body of evidence documenting microplastic contamination in tropical coastal ecosystems. Continued monitoring, improved waste management practices, and targeted pollution-control strategies are recommended to reduce plastic inputs into coastal environments and mitigate the long-term ecological consequences of microplastic accumulation in marine sediments.

Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author Contributions

All authors contributed equally to the conception and design of the study, data collection, data analysis, interpretation of results, manuscript preparation, and revision. All authors have read and approved the final version of the manuscript.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. All data generated or analyzed during this study are included in this published article and its supplementary materials, where applicable.

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