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Analysis of the Characteristics and Abundance of Microplastics in the Waters of Youtefa Bay, Papua

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Keywords

Accumulation; Anthropogenic; Extraction; Microplastic; Youtefa Bay

Abstract

Microplastics are persistent pollutants that can be readily dispersed by ocean currents and have the potential to accumulate in the water column, sediments, and marine organisms. Youtefa Bay is surrounded by densely populated settlements, tourism activities, marine transportation, and ongoing development that supports local livelihoods. The accumulation of microplastics in marine organisms may cause ecological and toxicological impacts and may also have implications for seafood safety among coastal communities. The research conducted at Youtefa Bay with methods included sample collection, sample extraction, sample filtration, microplastic identification, and abundance analysis. The results showed that a total of 1,463 microplastic particles were identified across the three sampling stations, with total microplastic abundance is 5,852 particles/m3. The microplastics identified consisted of fiber, fragments , film , pellets , and foam. Based on colour, seven variations were identified, namely red, brown, transparent, grey, blue, yellow, and green.

INTRODUCTION

Plastic pollution in marine environment is currently a global issue receiving serious attention because of its broad impacts on aquatic ecosystems and marine organism health. Plastics that undergo physical and chemical degradation form small particles known as microplastics (<5 mm). Microplastics are persistent, readily dispersed by ocean currents, and have the potential to accumulate in the water column, sediments, and marine organisms. The presence of microplastics in coastal environments not only reflects pressure from anthropogenic activities but also poses a real threat to the sustainability of coastal ecosystems.

Youtefa Bay is one of the important coastal areas in Jayapura City with high ecological, social, and economic value. The area is surrounded by densely populated settlements, tourism activities, marine that supports local livelihoods. Three rivers, namely the Hanyaan, Acai, and Siborogonyi Rivers, discharge into Youtefa Bay (Kainama et al., 2023). These conditions make Youtefa Bay particularly vulnerable to the influx of land-based plastic waste, which can subsequently undergo fragmentation into microplastics and become dispersed throughout the water column. However, scientific investigations specifically addressing the characteristics of microplastics in Youtefa Bay remain limited. Existing information is generally broad and does not yet describe in detail the types, sizes, and dominant forms of microplastics occurring in these waters (Rohmah et al., 2025).

Microplastics can easily be ingested by aquatic organisms because their very small size and broad

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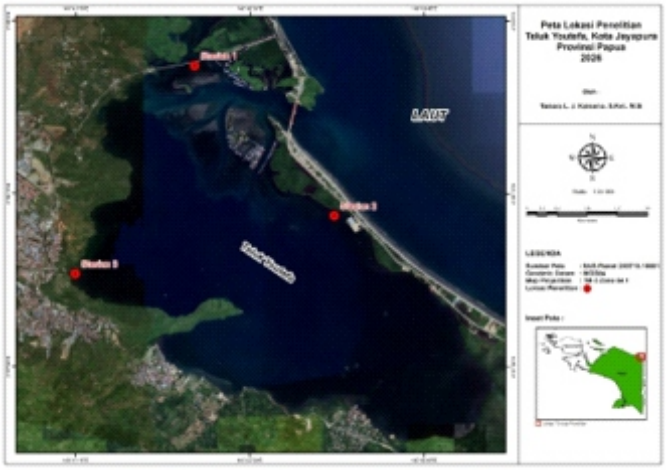
distribution patterns similar to plankton. Therefore, the presence of microplastics in waters can readily enter the food chain (Cahyaningtyas & Chandra, 2024). Microplastics can serve as vectors for pathogenic bacteria including Vibrio and Aeromonas. They can also function as contaminant transporters because they are capable of binding environmental additives and pollutants such as heavy metals, pesticides, pharmaceuticals, and various persistent organic pollutants Microplastics present in the water column and sediments can readily enter the food chain through ingestion by marine organisms such as fish and benthic invertebrates (Gateuille & Naffrechoux, 2022).

The accumulation of microplastics in marine organisms may lead to adverse ecological and toxicological effects, with potential implications for seafood safety and human health in coastal communities. Therefore, investigating microplastic characteristics in aquatic environments is essential for understanding the extent and spatial distribution of microplastic pollution in aquatic ecosystems. Based on these conditions, this study was conducted to assess the characteristics and abundance of microplastics in the waters of Youtefa Bay, Jayapura City.

RESEARCH METHOD

The study was conducted for six months in the waters of Youtefa Bay. Three sampling stations were selected for water sampling based on the intensity of anthropogenic activities in the surrounding community. Sampling locations were determined using purposive sampling based on the characteristics and level of anthropogenic activity in the study area, including locations around residential settlements and locations with relatively limited human activity as comparison sites. Seawater samples were collected from the surface layer at a depth of approximately 0–30 cm using a plankton net or by direct filtration of a predetermined volume of water.

Filtration was conducted carefully and gradually to reduce the possibility of particle damage or microplastic loss during the filtration process. The filtered material was then transferred into thoroughly washed and cleaned glass bottles and tightly sealed to prevent contamination from the surrounding environment. Samples were preserved using 70% alcohol and stored at room temperature until laboratory analysis. To maintain sample quality and minimize the possibility of cross-contamination, all stages of collection, filtration, and storage were conducted using non-plastic equipment or by minimizing the use of plastic materials. This step was intended to



Source: Processed Primary Data, (2026)

Figure 1
Research Map

reduce the possibility of microplastic particles originating from research equipment entering the samples, thereby improving the accuracy and scientific reliability of the results.

A 250 mL water sample from each sampling location was homogenized by gently shaking it so that particles within the sample were evenly distributed. The sample was then mixed with 500 mL of NaCl solution and stirred for 2 minutes. The mixture was covered with aluminum foil for 2 hours. After 2 hours, the microplastics floating in the sample were collected using a filter cloth, followed by the addition of 20 mL of H_2O_2 solution. The sample was covered again with aluminum foil and placed in an oven for 24 hours at 60°C.

The supernatant obtained from the density-separation extraction process was filtered using vacuum filtration with Whatman filter paper. The sample was vacuum-filtered until all water had passed through. The filtered material was transferred to a Petri dish and dried in an oven at 60°C until completely dry.

The dried samples were examined under a stereo microscope at magnifications ranging from 10x to 40x. Each particle suspected to be microplastic was counted and documented using a microscope camera.

Identification was based on morphological characteristics, including the type or form of microplastic, colour (for example black, blue, red, white, transparent, green, yellow, and other colours), and the number of particles in each sample.

A particle was considered microplastic when it showed no biological structure, had a relatively uniform shape and homogeneous surface, and did not exhibit natural fragmentation characteristics typical of organic material.

The data consisted of microplastic identification and abundance data, which were analyzed using descriptive and quantitative approaches by comparing field observations to relevant research findings. Data were presented in graphs, figures, and tables. According to Laila et al. (2020), microplastic abundance was calculated using the following equation:

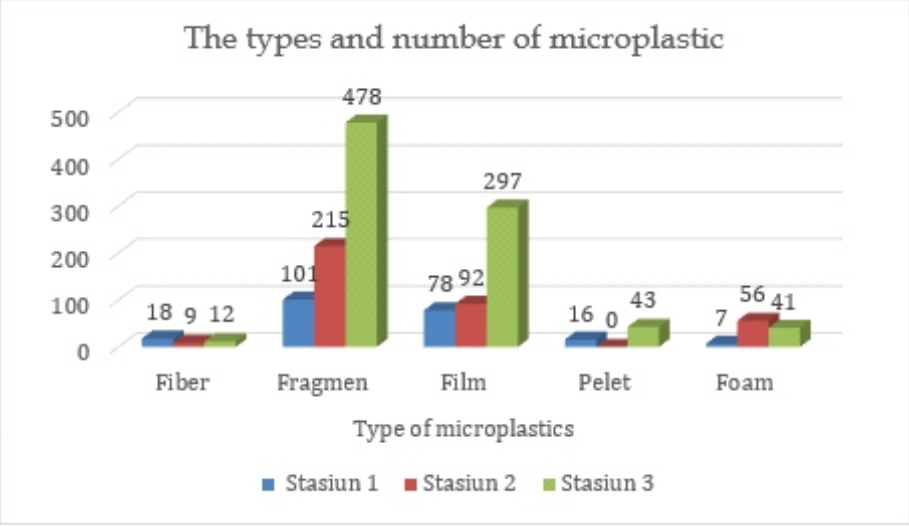
$K = n/v$

Where K is microplastic abundance (particles m^{-3}), n is number of microplastic particles, and V is sample volume.

RESULT AND DISCUSSION

Microplastic Characteristics

Based on the research results from the three stations in Youtefa Bay, five types of microplastics were identified: fiber, fragment, film, pellet, and foam. All microplastic types were found at every



Source: Processed Primary Data, (2026)

Figure 2
Mechanism of Cd in Causing Immunotoxicity

station, except pellets, which were not found at Station 2. These five types have different morphological characteristics, sources, formation mechanisms, and behaviour in aquatic environments.

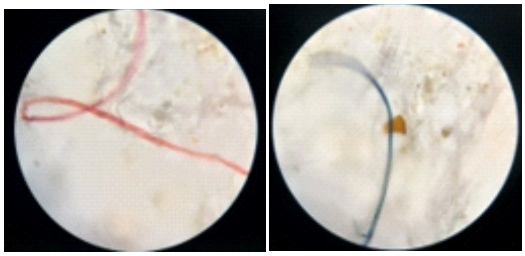
Fiber is a microplastic in the form of a long, thread-like strand with a relatively thin structure. This form generally originates from synthetic textile fibers such as polyester, nylon, acrylic, polypropylene, and polyethylene released during clothes washing and textile-industry activities. Fiber may also originate from ship ropes, aquaculture ropes, fishing nets, synthetic lines, and various fishing equipment that undergo weathering in the marine environment (Browne et al., 2011).

The presence of fibers in Youtefa Bay is closely related to activities of communities living along the coast. Domestic waste discharged through drainage channels into rivers and subsequently into Youtefa Bay represents a major pathway for synthetic fibers to enter the marine environment. This situation may be further aggravated by inadequate domestic waste management. In addition to household activities, the presence of fibers in Youtefa Bay is also suspected to be influenced by traditional fishing activities (Napper & Thompson, 2016).

The use of nets, ship mooring ropes, fishing lines, and various synthetic fishing gear that become damaged can generate microplastic fibers. Over time, exposure to sunlight, wave abrasion, and friction with sediments causes ropes and nets to degrade, producing increasing quantities of fibers. These findings indicate that domestic waste remains a major contributor to microplastic pollution in Indonesian coastal areas (Cole et al., 2013).

The next type of microplastic found in Youtefa Bay was fragment. This type was most abundant at Station 3, which receives discharge from the Acai River, where considerable quantities of waste enter Youtefa Bay. Fragments are irregularly shaped plastic particles originating from the breakage of larger plastic items such as beverage bottles, food containers, buckets, PVC pipes, plastic toys, detergent packaging, and other household products. Fragments are secondary microplastics formed through the degradation of macroplastics. Exposure to ultraviolet radiation causes cracking of polymer structures, making them easier to break into smaller pieces. Abrasion caused by waves, currents, and sediment friction subsequently accelerates the fragmentation of plastic into microplastics (Andrady, 2011).

Fragments have relatively rough surfaces and can adsorb contaminants such as heavy metals, pesticides, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Therefore, fragments function not only as physical pollutants but also as transport media for various hazardous chemicals in the marine environment (Rochman et al., 2013). Their relatively small size allows fragments to be readily ingested by marine organisms ranging from zooplankton to commercially consumed fish.



Source: Processed Primary Data, (2026)

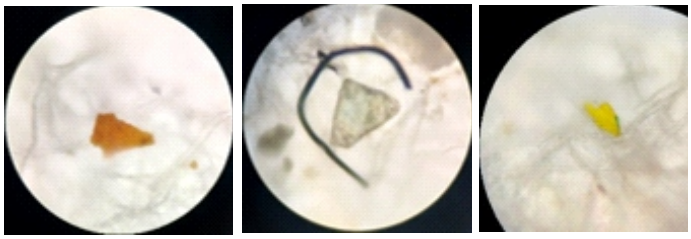
Figure 3
Fiber-type microplastic

The accumulation of fragments in the digestive tract may lead to reduced food intake, metabolic disturbances, reduced growth, and, under sufficiently high exposure levels, mortality.

The occurrence of fragment-type microplastics in Youtefa Bay indicates the substantial accumulation of plastic debris in the coastal environment. Youtefa Bay is surrounded by residential areas, economic activity centres, tourism facilities, and several river mouths, allowing various types of plastic waste to enter the waters daily. Floating waste then gradually degrades and produces large quantities of fragments.

use of single-use plastics by local communities. Trading activities, tourism, households, and traditional markets generate large quantities of plastic-bag waste. This plastic is transported by river flows into Youtefa Bay and subsequently degrades into film-shaped microplastics.

In mangrove and seagrass ecosystems, film is often found attached to roots or leaves because it becomes trapped during tidal processes. Accumulation of film in coastal ecosystems may interfere with oxygen exchange, reduce light penetration, and affect seagrass photosynthesis when present in high quantities.



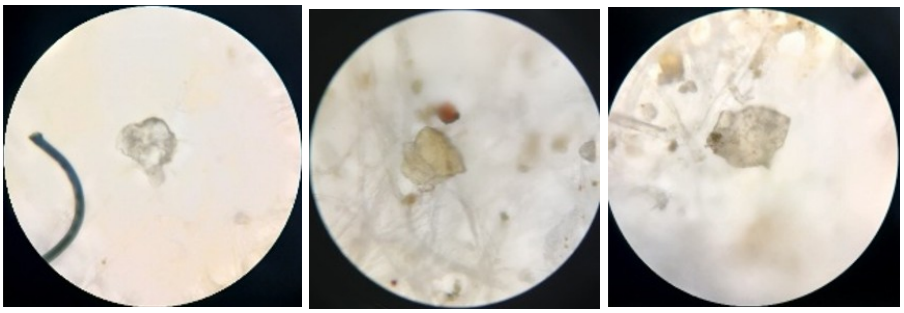
Source: Processed Primary Data, (2026)

Figure 4
Fragment-type microplastic

The third type of microplastic identified was film. Film consists of thin sheet-like plastic particles originating from plastic bags, food wrappers, plastic packaging, and other single-use plastic products. Based on the results from the three stations, film was abundant at Station 3. Film particles have low mass and are therefore easily transported by wind and water currents.

The presence of film-type microplastics in Youtefa Bay indicates intensive

Film can also adsorb microorganisms and therefore become a substrate for bacterial, fungal, and biofilm colonization (Putri et al., 2026). This phenomenon is known as the plastisphere, a community of microorganisms living on plastic surfaces in marine environments (Zettler et al., 2013). The dominance of film-type microplastics at coastal stations in several studies is frequently associated with high use of plastic bags and single-use food packaging.



Source: Processed Primary Data, (2026)

Figure 5
Film-type microplastic

The fourth type identified was pellet. Pellets are round or oval plastic particles with relatively uniform sizes. Unlike fiber, fragment, and film, which are generally secondary microplastics, pellets are primary microplastics because they are directly produced by industry as raw materials for manufacturing various plastic products.

The presence of pellets in Youtefa Bay may originate from the distribution of plastic industrial raw materials, marine transportation activities, or spills during transport. In addition, some cosmetics and cleaning products in the past used pellet-shaped microbeads as additives, although their use has now been restricted in many countries. The number of pellets in Youtefa Bay was generally lower than that of fibers and fragments. This is consistent with various studies in Indonesia showing that the main sources of microplastics in coastal areas are more frequently associated with degradation of domestic plastic waste than industrial waste.

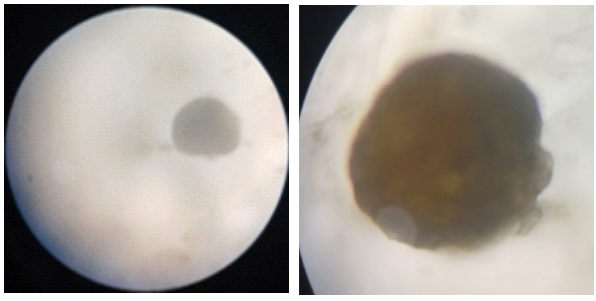
Nevertheless, the presence of pellets, even in smaller quantities, indicates the possibility of primary microplastics entering the aquatic environment through goods distribution, marine transportation, and spills of plastic raw materials during transport. Although their contribution is relatively small compared with fibers and fragments, pellets remain important because they can adsorb persistent organic compounds from the marine environment and heavy metals, potentially increasing toxicity and exposure risks to organisms that ingest them (Rochman et al., 2013).

Foam-type microplastic is a form of plastic particle that can occur in aquatic environments and is characterized by a lightweight, porous, and generally irregular structure. Foam may originate from expanded polystyrene (EPS), commonly known as styrofoam, as well as other foamed plastics used as food packaging, storage containers, protective materials, and materials supporting fisheries and trading activities. Because of its low density, foam tends to float at the water surface and can be readily transported by wind, waves, and surface currents (Dewi et al., 2015).

The low density of foam causes these particles to remain at the surface or in the upper layer of the water column, making their distribution strongly influenced by wind and surface currents. However, after the foam surface is colonized by microorganisms or covered by biofilm, its effective density may increase, allowing the particles to move into the water column and eventually accumulate in sediments (Joesidawati, 2018). This is particularly relevant to Youtefa Bay, where mangrove ecosystems can act as natural traps for waste and particles transported by water currents, potentially increasing their interaction with benthic organisms and fish inhabiting these areas (Dosinaeng et al., 2026).

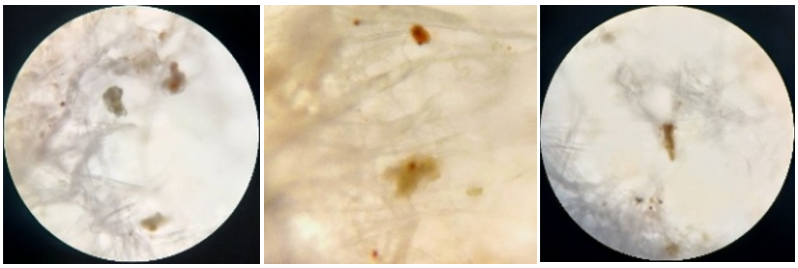
Microplastic Colour

Based on the results shown in Figure 8, microplastics in the waters of Youtefa Bay exhibited seven colour variations: red, brown, transparent, grey, blue, yellow, and green, with a total of 1,463 particles. Red was the dominant colour, with 435



Source: Processed Primary Data, (2026)

Figure 6
Pellet-type microplastic



Source: Processed Primary Data, (2026)

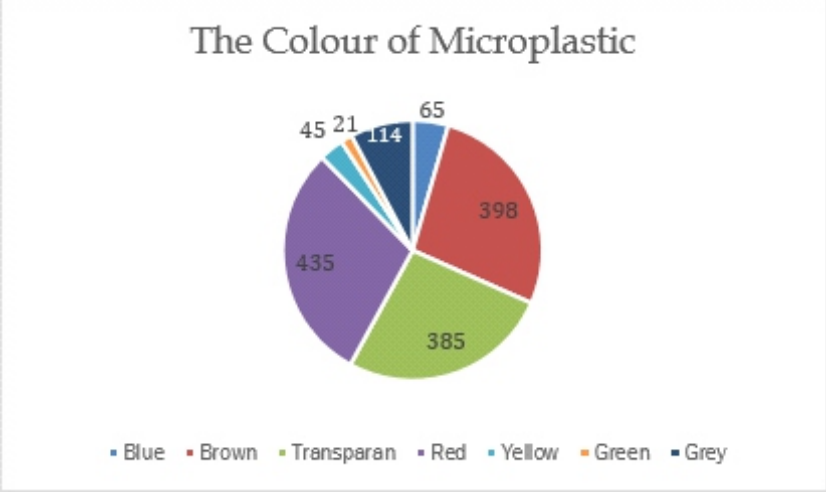
Figure 7
Foam-type microplastic

particles (29.73%), followed by brown with 398 particles (27.20%), transparent with 385 particles (26.32%), grey with 114 particles (7.79%), blue with 65 particles (4.44%), yellow with 45 particles (3.08%), and green with 21 particles (1.44%).

The dominance of brown-colored microplastics suggests that these particles may have undergone weathering and surface alterations during their exposure to aquatic environments. The original color of plastic can change due to exposure to ultraviolet (UV) radiation, oxidation, abrasion, and the accumulation of organic matter and biofilms. These processes may cause plastics that originally had distinct colors to become duller or brownish. In addition, the brown coloration may indicate that the particles have interacted with sediment, organic matter, and other materials present in the aquatic environment (Aini & Andira, 2026).

Microplastic colour may also change through exposure to ultraviolet radiation, oxidation, physical abrasion, and biofilm formation. Therefore, colour alone cannot reliably indicate the origin of plastic particles (Firdaus et al., 2020). The relatively high proportion of transparent particles may be associated with the use of clear plastics and single-use packaging that are easily transported by runoff and surface flows into coastal areas, whereas blue, green, and yellow particles, which occurred in lower numbers, may originate from the degradation of ropes, nets, fishing equipment, and other coloured plastic products. These colour variations indicate that microplastic pollution in Youtefa Bay may originate from various anthropogenic activities around Jayapura City, including settlements, trade, fisheries, and tourism.

In addition to being a physical characteristic of pollution, microplastic



Source: Processed Primary Data, (2026)

Figure 8
Microplastic Colour Diagram

Table 1
Microplastic Abundance

Station	Fiber	Fragment	Film	Pellet	Foam	Total	Abundance
Station 1	18	101	78	16	7	220	0.88
Station 2	9	215	92	0	56	372	1.488
Station 3	12	478	297	43	41	871	3.484
Total	**39**	**794**	**467**	**59**	**104**	**1,463**	**5.852**

Source: Processed Primary Data, 2026

colour is ecologically important because certain coloured particles may resemble natural food and consequently be ingested by aquatic organisms. Therefore, the findings indicate that microplastics in Youtefa Bay have diverse characteristics and should be investigated further through a combination of colour, shape, size, and polymer-type identification to determine their sources and potential impacts on coastal ecosystems.

Microplastic Abundance

The abundance results in Table 1 showed 220 particles at Station 1, 372 particles at Station 2, and 872 particles at Station 3. Based on the calculated abundance, Station 1 had 0.88 particles/m^3, Station 2 had 1.488 particles/m^3, and Station 3 had the highest abundance at 3.484 particles /m^3.

Microplastic abundance showed a clear increasing trend from Station 1 to Station 3. The abundance at Station 3 was approximately 2.34 times higher than that at Station 2 and nearly four times higher than that at Station 1. These findings suggest that microplastics are unevenly distributed throughout Youtefa Bay, potentially reflecting spatial variations in environmental conditions, pollution sources, anthropogenic activities, and particle transport and deposition processes.

When all stations were combined, the total number of microplastics reached 1,463 particles. Of these, fragments were the most dominant type, with 794 particles (54.27%), followed by film with 467 particles (31.92%), foam with 104 particles (7.11%), pellets with 59 particles (4.03%), and fiber with 39 particles (2.67%). This composition shows that microplastic characteristics in Youtefa Bay were dominated by fragments, followed by film, foam, pellets, and finally fibers.

The dominance of fragments indicates that fragmentation of macro-sized plastic waste may be one of the main sources of microplastics in Youtefa Bay. Fragments may originate from various plastic products, including bottles, food containers, packaging, buckets, household items, and other plastic materials that undergo degradation after entering the environment. Exposure to ultraviolet radiation can alter polymer structures and increase plastic brittleness, while wave action, currents, temperature fluctuations, and friction with sand or sediment further accelerate the fragmentation process, resulting in the formation of smaller particle (Hidalgo-Ruz et al., 2012).

Fragment-type microplastics have also been reported in several studies in Indonesia. Dewi et al. (2015) identified microplastics in sediments from Muara Badak, East Kalimantan, and attributed their presence to the degradation of plastic waste entering coastal environments. Cordova & Wahyudi (2016) also found microplastics in marine sediments in southwestern Sumatra, demonstrating that microplastics can undergo transport and deposition in marine environments. Thus, the predominance of fragment-type microplastics in Youtefa Bay may indicate the continuous weathering and fragmentation of larger plastic debris entering the aquatic environment.

CONCLUSION

The waters of Youtefa Bay, Jayapura City, were found to be contaminated with microplastics, exhibiting variations in abundance, type, and colour across sampling stations. Microplastic abundance showed an increasing trend from Station 1 to Station 3, with the highest abundance recorded at Station 3. Five microplastic types were identified: fibers, fragments, films, pellets, and foams, with fragments being the most dominant, followed by films. Seven colours were observed, namely red, brown, transparent, grey, blue, yellow, and green. Red was the most frequently observed colour, followed by brown and transparent.

REFERENCES

Aini, Y. D. N., & Andira, R. C. (2026). Distribution and Characteristics of Microplastics in Plastic-Mulched Farmland in Wringinanom Subdistrict, Gresik. Environmental Pollution Journal, 6(2), 259–268. https://ecotonjournal.id/index.php/epj/article/view/380

Andrady, A. L. (2011). Microplastics in the marine environment. Marine Pollution Bulletin, 62(8), 1596–1605. https://doi.org/10.1016/j.marpolbul.2011.05.030

Browne, M. A., Crump, P., Niven, S. J., Teuten, E., Tonkin, A., Galloway, T., & Thompson, R. (2011). Accumulation of Microplastic on Shorelines Woldwide: Sources and Sinks. Environmental Science & Technology, 45(21), 9175–9179. https://doi.org/10.1021/es201811s

Cahyaningtyas, D. A., & Chandra, A. B. (2024). Identifikasi Mikroplastik pada Air Kolom dan Sedimen di Kanal Sidoarjo. Environmentall Pollution Journal, 4(1), 906–917. https://ecotonjournal.id/index.php/epj/article/view/162/96

Cole, M., Lindeque, P., Fileman, E., Halsband, C., Goodhead, R., Moger, J., & Galloway, T. S. (2013). Microplastic Ingestion by Zooplankton. Environmental Science & Technology, 47(12), 6646–6655.https://pubs.acs.org/esthag/articleabstract/47/12/6646/840024/Microplastic-Ingestion-byZooplankton?redirectedFrom=fulltext

Cordova, M. R., & Wahyudi, A. J. (2016). Microplastic in the deep-sea sediment of Southwestern Sumatera waters. Marine Research in Indonesia, 41(1). https://ejournal.brin.go.id/mri/article/view/14773

Dewi, I. S., Budiarsa, A. A., & Ritonga, I. R. (2015). Distribusi Mikroplastik pada Sedimen di Muara Badak, Kabupaten Kutai Kartanegara. Depik: Jurnal Ilmu Ilmu Perairan, Pesisir, Dan Perikanan, 4(3). https://jurnal.usk.ac.id/depik/article/view/2888

Firdaus, M., Trihadiningrum, Y., & Lestari, P. (2020). Microplastic in the sediment of Jagir Estuary, Surabaya, Indonesia. Marine Pollution Bulletin, 150. https://www.sciencedirect.com/science/article/abs/pii/S0025326X19309464

Gateuille, D., & Naffrechoux, E. (2022). Transport of persistent organic pollutants: Another effect of microplastic pollution? Wiley Interdisciplinary Reviews: Water, 9(5).https://doi.org/10.1002/wat2.1600

Hidalgo-Ruz, V., Gutow, L., Thompson, R. C., & Thiel, M. (2012). Microplastics in the Marine Environment: A Review of the Methods Used for Identification and Quantification. Environmental Science & Technology, 46(6), 3060–3075. https://pubs.acs.org/esthag/articleabstract/46/6/3060/1577896/Microplastics-in-the-Marine-Environment-AReview?redirectedFrom=fulltext

Joesidawati, M. I. (2018). Pencemaran Mikroplastik di Sepanjang Pantai Kabupaten Tuban. Prosiding Seminar Nasional Hasil Penelitian

Dan Pengabdian Kepada Masyarakat III. https://prosiding.unirow.ac.id/index.php/SNasPPM/article/view/135

Kainama, T. L. J., Wijayanti, D. P., Sabdono, A., & Dirgantara, D. (2023). DNA Barcoding and Morphological Characters of Two Trevally Fish species (Caranx spp.) Collected from Youtefa Bay, Papua, Indonesia. IJMS Ilmu Kelautan Indonesian Journal of Marine Sciences, 28(1), 97–104. https://doi.org/10.14710/ik.ijms.28.1.97-104

Napper, I. E., & Thompson, R. C. (2016). Release of synthetic microplastic plastic fibres from domestic washing machines: Effects of fabric type and washing conditions. Marine Pollution Bulletin, 112(1–2), 39–45. https://www.sciencedirect.com/science/article/abs/pii/S0025326X16307639

Putri, D. D., Galuh, S. D., Umarie, W. I., Al-Rosyud, L. M., & Siswanti, Y. D. (2026). Microplastic Abudance in Mangrove Sediments Based on Mangrove Density at Cemara Beach, Jember. Environmentall Pollution Journal, 6(2), 183–191. https://ecotonjournal.id/index.php/epj/article/view/504/183

Rochman, C. M., Hoh, E., Kurobe, T., & Teh, S. J. (2013). Ingested plastic transfers hazardous chemicals to fish and induces hepatic stress. Scientific Reports, 3(3263). https://www.nature.com/articles/srep03263

Rohmah, S. M., Triajie, H., Hafiludin, H., & Chandra, A. B. (2025). Karakteristik Mikroplastik Pada Sumber Air Baku Dan Sedimen Tambak Garam Di Pamekasan Dengan Metode Ft-Ir. Journal of Indonesian Tropical Fisheries, 8(1), 12–27. https://jurnal.fpik.umi.ac.id/index.php/JOINT-FISH/article/view/572

Zettler, E. R., Mincer, T. J., & Amaral-Zettler, L. A. (2013). Life in the "Plastisphere": Microbial communities on plastic marine debris. Environmental Science & Technology, 47(13), 7137–7146. https://pubs.acs.org/esthag/article abstract/47/13/7137/1546848/Life-in-the-Plastisphere-Microbial-Communitieson?redirectedFrom=fulltext