RUMPHIUS PATTIMURA BIOLOGICAL JOURNAL
Volume 7, Issue 1 (2025), 019-024
E-ISSN: 2684-804X
DOI: 10.30598/rumphiusv7i1p019-024

STUDY ON THE PRESENCE OF MICROPLASTIC IN SILOWO ECOTOURISM WATERS, TUBAN REGENCY, EAST JAVA

Rahmah Arfiyah Ula [1*] Merinda Nur Indahsari [1] Fita Fitriatul Wahidah [1]

Lilik Erviani [1] Sitti Nur Ilmiah [1] Innarotul Ulya [1]

[1] Department of Biology, Billfath University, PP Al-Fattah, Siman, Sekaran, Lamongan, East Java, 62261, Indonesia
*Corresponding Author: rahmahaarfiyah@gmail.com

Article History:
Submitted:
December 26th 2024
Accepted:
March 2th 2025
Published:
March 20th 2025

Keywords:
anthropogenic, microplastic, ecotourism.

ABSTRACT

Silowo Ecotourism is one of the water-based recreational facilities that offers swimming and anthropogenic activities that have recently been operating. The existence of ecotourism Silowo stimulates economic activity for the surrounding residents. The high anthropogenic and recreational activity ecotourism Silowo initiated this study to determine the presence of microplastic pollutants in these waters including microplastics amounts, microplastics colors, and microplastics types. Sampling was carried out at four stations in the waters of ecotourism Silowo. The identification of microplastics begins with sample preparation, degradation of organic matter with 30% HNO_3, density separation using NaCl, and observation under a microscope. The observation results showed that there were microplastics in the four observation stations. Microplastics found are fibers, pellets, fragments, and films. Based on the type, film is the most numerous microplastics in this study, 38 particles. The colors of microplastics found in this study are green, blue, yellow, red, black, brown, white, and transparent. Microplastics in waters can come from anthropogenic activities around the waters as well as tourist activities in the waters, such as swimming.

How to cite this article:
Ula, R.A., Indahsari, M.N., Wahidah, F.F., Erviani, L., Ilmiah, S.N. & Ulya, I. (2025). Study on the presence of microplastic in silowo ecotourism waters, Tuban Regency, East Java. *Rumphius Pattimura Biological Journal.* 7(1), 019-024.
https://doi.org/10.30598/rumphiusv7i1p019-024

Journal Homepage: https://ojs3.unpatti.ac.id/index.php/rumphius
Journal E-mail: rumphiusbiojournal@gmail.com
Research Article: Open Access

INTRODUCTION

Indonesia has a lot of natural-tourism potential to develop. These days, many natural-based attractions are popping up by utilizing local potentials. Tourism is an activity or trip made by individuals or groups to a place for enjoyment (Arida, 2017). Tourism should carry out concepts that are able to support the sustainability of object offered to the society until the future. Tourism is considered sustainable if it meets several conditions, such as: 1) ecologically sustainable, i.e. tourism activities do not have a negative impact on the local ecosystem and carry out ecosystem conservation efforts, 2) can be socially acceptable without conflict, 3) can be culturally acceptable, meaning that visitors' habits can be accepted by the local community, and 4) economically profitable, especially for the welfare of the community (Arida, 2017).

Silowo Ecotourism which located in Mandirejo Village, Merakurak District, Tuban Regency is one of the natural tourism objects that has recently been operated. This ecotourism facilitates visitors with canoe paddle rides and swimming in natural waters. Silowo Ecotourism is surrounded by sago plantations owned by the local community, making this natural tourism increasingly popular. Carrying the concept of local community development, the existence of ecotourism provides opportunities for local residents to engage in the economic sector. Many residents around Silowo Ecotourism are making stalls and sell snacks and drinks. Thus, it can be said that there are many anthropogenic activities in the Silowo Ecotourism area (Yu et al., 2020).

The presence of activities at tourist attractions has been reported to generate a significant amount of waste from human activities. The amount of waste will increase in accordance with the growing number of tourists, especially during weekends and holiday periods (Titah et al., 2024). The waste generated at tourist sites varies, including both organic and inorganic waste. The study conducted by (Aziz et al., 2020) shows that waste composition in a tourist location is dominated by food waste (28.32%), plastic (26.30%), paper (17.46%), and yard waste (12.55%). Plastic waste dominates the generation of waste after food waste. Plastic waste has the potential to be recycled. On the other hand, plastic waste that is not handled properly can become pollutants in the environment, one of which becomes microplastics.

Microplastics are plastics that are less than 5 mm in size. Based on their source, microplastics can be classified into two kinds. The first kind is microplastics that come from pressure processes or plastics that have been worn down to form small materials, like the plastics found in cleaning products, for example, the particles in facial wash (Yona et al., 2021; Yu et al., 2020). These first type of microplastics enter the environment already in small size (Yona et al., 2021). The second kind is microplastics that come from plastic materials that have fragmented either physically, chemically, or biologically into smaller plastics (Yu et al., 2020). So, when in the environment, these plastic materials need to go through various degradation processes to form microplastics.

The presence of microplastics in the environment has a bad influence on the surroundings. Microplastics are reported to be able to trap various chemical contaminants in the vicinity, including PAHs (polycyclic aromatic hydrocarbons), PCBs (polychlorinated biphenyls), antibiotics, and DDT (Yu et al., 2020). The ability of microplastics to absorb these materials makes microplastics have a worse effect if they enter human digestion where later the substances carried by these microplastics are absorbed by the digestive system. Human activities are really high and that affects the amount of waste generated (Yu et al., 2020).

Some studies have reported the presence of microplastics in tourist areas. Microplastics have been reported as contaminants in Lake Nikli in Bangladesh. Lake Nikli is a tourist spot that offers boating and fishing facilities. These activities contribute to the presence of microplastics in the water, with 98,167 ± 12,849 pieces/m^3, mainly from fishing activities (Islam et al., 2024). Meanwhile, the presence of microplastics in recreational areas has been reported to show higher amounts compared to residential and industrial areas in Istanbul, Turkey. Recreational zones show the highest abundance (mean = 7956 items/kg) (Tunali et al., 2022). Based on the high anthropogenic and recreational activity in Silowo Ecotourism, it is necessary to know the presence of microplastic pollutants in these waters including microplastics amounts, microplastics colors, and microplastics types.

MATERIALS AND METHOD

The research was conducted from December 2023 to February 2024. Sampling was carried out in the waters of Silowo Ecotourism, Tuban Regency and microplastics identification continued at the Biology Laboratory of Billfath University. Water samples were taken from four different stasions along the waters at the Silowo Ecotourism and filtered using a 25 µm plankton net. After obtaining water samples, further identification

was carried out referring to Yona et al. (2021) and Pradiptaadi & Fallahian (2022) (Pradiptaadi & Fallahian, 2022; Yona et al., 2021) which were modified.

Microplastics identifications starts with filtering the sample. Then it's followed by degrading organic material containing in sample using 30% HNO_3 and density separation using NaCl. The degradation of organic material and density separation are each done for 24 hours. The next sample is filtered using filter paper and observed under a microscope when it is dry in 10x10 magnification. Microplastics amounts, microplastics colors, and microplastics types then be identified.

RESULTS AND DISCUSSION

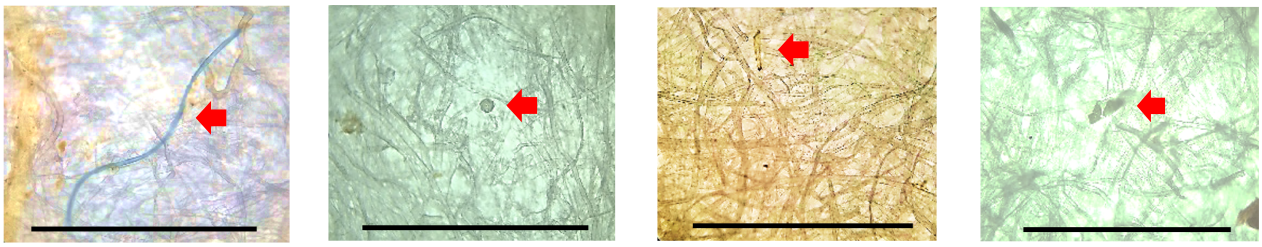
The sampling locations are spread across four stations shown in the table below (Table 1). The results show that microplastics were found at all four sampling locations.

Table 1. Sampling distribution

Stations	Coordinate	Descrioption
1	S06°52.967' E111°59.097'	The water at the edge of the buoy storage (outside the swimming area and canoe tracks)
2	S06°52.957' E111°59.102'	Swimming area
3	S06°52.934' E111°59.090'	Canoe tracks
4	S06°52.863' E111°59.100'	End of canoe tracks

Authors' document, 2025

The types of microplastics found include fibers, pellets, fragments, and films (Figure 1). This is similar to the sesearch conducted by Ibrahim et al. (2023). The film was found the most at station 1, station 2, and station 3. Meanwhile, fiber was the most common type found at station 3, with 18 particles (Figure 2). Pellet was found the most at station 3, with a total of 13 particles. Fiber is a microplastic in the form of fibers or filamentous, for example yarn residues or fishing line. Pellet-shaped microplastics look like balls, for example scrubs on facial soap. Meanwhile, microplastics in the form of fragments look like plastic fragments that were originally large in size and broke into small parts. Film is a microplastic that has the characteristics of thin sheets (Yona et al., 2021).



(a) (b) (c) (d)

Figure 1. Types of microplastics found in this study (line measures as 1 mm), fiber (a); pellet (b); fragment (c); film (d).

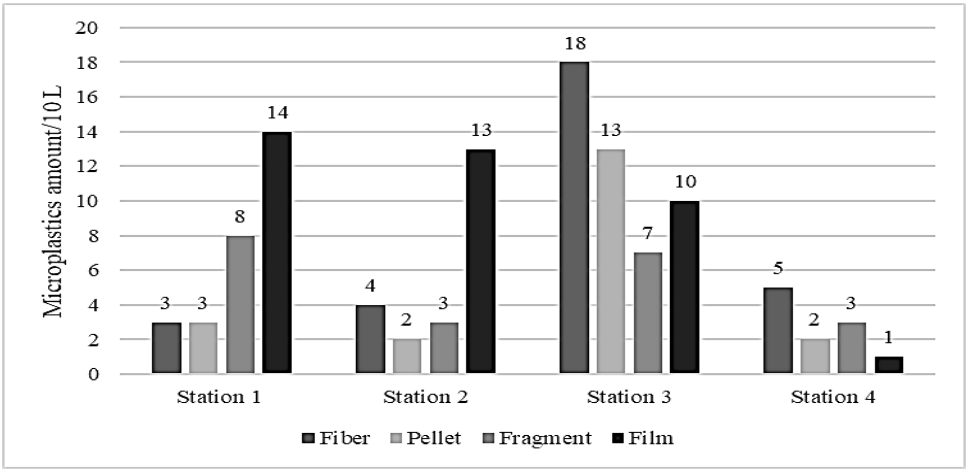


Figure 2. Microplastic amounts by types

The picture above (Figure 2) shows that station 3 has the most microplastics, with a total of 48 particles. This is thought to be related to the sampling location. The sampling location of station 3 is in an area of water that juts out a bit towards the land. This causes the water current to be not as strong as at station 1, station 2, and station 4. This is relevant to the statement that water currents affect the retention time of microplastics (Tuhumury and Ritonga, 2020). Station 4 showed the least amount of microplastics, 11 particles, compared to the other three stations. This can happen because station 4 is near the waterway that passes through the dam, so it has a heavy flow, so microplastics tend to be carried away by the current.

Tabel 2. The amount of microplastics by type

Microplastic type	Station 1	Station 2	Station 3	Station 4	Total per type
Fiber	3	4	18	5	30
Pellet	3	2	13	2	20
Fragment	8	3	7	3	21
Film	14	13	10	1	38
Total per station	28	22	48	11	-

Based on the table above, film is the most widely found microplastic based on its type, 38 particles. Film can come from plastic packaging fragments or other thin plastics as a wrapper for detergent or shampoo products in sachet packaging (Ibrahim et al., 2023). Films also dominate the types of particles found in station 1. This is estimated because station 1 is close to residential areas, so residents' activities affect the disposal of their waste into the waters. Meanwhile, fiber is the second most common microplastic after film. Fiber can come from clothing waste or fishing line or nets washed into aquatics environment. This might happen in relation to the swimming activities offered by Silowo Ecotourism. Fiber from clothing and life jackets might get washed away and carried by the current. Similar research on the presence of microplastics in aquatic environments conducted by (Chandrakanthan et al., 2024) shows that swimming activities influence the presence of microplastics from swimwear, especially during peak activity.

The colors of microplastics found in this study are green, blue, yellow, red, black, brown, white, and transparent. The microplastics in the form of fibers found have green, blue, red, and black colors. Meanwhile, the shape of the fragments found shows black and transparent colors. The pellets found are white and black. Meanwhile, the films found were brown, yellow, green, and transparent.

The existence of microplastics in nature is certainly influenced by various things. Microplastics can enter the environment due to natural activities such as being carried away by currents or carried by the wind. However, the existence of microplastics in nature is inseparable from human activities around them. This anthropogenic activity carries microplastic components through various pathways. Microplastics are reported to be pollutants in lakes through rainwater runoff that falls to the surface, agricultural activities, as well as through wastewater.

The distance of the lake to the settlement was positively correlated with the presence of microplastic pollutants in the observed lake waters (Grbić et al., 2020).

This is supported by other studies that show the highest point of microplastics found in the Douro River. The first point that becomes a hotspot for the existence of microplastics is boat docks and wastewater disposal (Prata et al., 2021). Meanwhile, microplastics were found in coastal waters adjacent to anthropogenic activity in the Brazilian city of Fortaleza. Some sources of microplastic pollutants are fishing activities, food packaging, waste disposal, surface coatings of easily degradable objects, and vehicle wheels (Nolasco et al., 2022).

According the idea of sustainable tourism, a tourism object should maintain the ecological sustainability (Arida, 2017). This ecologically sustainable condition could be obtained if the tourism activities do not have a negative impact on the local ecosystem and carry out ecosystem conservation efforts. Therefore, the management of this ecotourism must take effective waste management actions, especially regarding plastic waste as a source of microplastic formation in the environment.

CONCLUSION

Microplastics found in this study include fibers, pellets, fragments, and films. Based on the type, the most commonly found microplastics are films followed by fiber, 38 and 30 respectively. Film comes from packaging plastic that is fragmented and carried into the waters, while fiber can come from nets, fishing lines, or tourist swimwear. In addition to human activities, water currents also affect the presence of microplastics in the aquatic environment. Station 3 is the point with the highest number of microplastics in this study, 48 particles found.

AUTHORS CONTRIBUTION

Ula, R.A. designed and conducted the study, Indahsari, M.N and Wahidah F.F., analyzed and interpreted and wrote the draft of the manuscript. Erviani, L., Ilmiah, S.N., and Ulya, I, designed study and interpreted the data, designed the graphs, and reviewed the draft of the manuscript and supervised the entire process.

ACKNOWLEDGEMENTS

The expression of gratitude is conveyed to Billfath University for their support of this research and to Silowo Ecotourism for allowing the author to collect data.

REFERENCES

Arida, I. (2017). Ecotourism: Development, Local Participation, and Ecotourism Challenges. Cakra Press.

Aziz, R., Dewilda, Y., & Putri, B. E. (2020). Initial study of waste management in the Carocok coastal tourism area, Painan City. Journal of Science and Technology, 20(1), 77-85.

Chandrakanthan K, Fraser M, Herckes P. 2024. Recreational activities as a major source of microplastics in aquatic environments. Water Emerging Contaminants & Nanoplastics (2024) 3(3). 10.20517/wecn.2024.40

Grbić, J., Helm, P., Athey, S., & Rochman, C. M. (2020). Microplastics entering northwestern Lake Ontario are diverse and linked to urban sources. Water Research, 174. https://doi.org/10.1016/j.watres.2020.115623

Ibrahim, F. T., Suprijanto, J., & Haryanti, D. (2023). Analysis of Microplastic Content in Sediments in Semarang Waters, Central Java. Journal of Marine Research, 12(1), 144-150.

Islam, A. R. M. T., Hasan, M., Sadia, M. R., Mubin, A. N., Ali, M. M., Senapathi, V., ... & Malafaia, G. (2024). Unveiling microplastics pollution in a subtropical rural recreational lake: A novel insight. Environmental Research, 250, 118543.

Nolasco, M., Lemos, V., Lopez, G., Soares, S., Feitosa, J., Araujo, B., Ayala, A., de Azevedo, M., Santos, F., & Cavalcante, R. (2022). Morphology, Chemical Characterization and Sources of Microplastics in a Coastal City in the Equatorial Zone with Diverse Anthropogenic Activities (Fortaleza city, Brazil). Journal of Polymers and the Environment, 30, 2862–2874.

Pradiptaadi, B., & Fallahian, F. (2022). Analysis of microplastic abundance in water and sediment in the downstream area of the Brantas River Basin. Environmental Pollution Journal, 2(1), 344–352. https://ecotonjournal.id/index.php/epj

Prata, J. C., Godoy, V., da Costa, J. P., Calero, M., Martín-Lara, M. A., Duarte, A. C., & Rocha-Santos, T. (2021). Microplastics and fibers from three areas under different anthropogenic pressures in the Douro river. Science of the Total Environment, 776. https://doi.org/10.1016/j.scitotenv.2021.145999

Titah, H. S., Tangahu, B. V., Purwanti, I. F., Mangkoedihardjo, S., Mashudi, M., Santoso, I. B., & In, H. (2024). Determining the generation rate and composition of waste in the community service program at the Kelapa Panyuran Beach tourist attraction, Tuban Regency. Sewagati, 8(4), 1900-1912.

Tuhumury, N., & Ritonga, A. (2020). Identification of the presence and types of microplastics in blood cockles (Anadara granosa) in Tanjung Tiram Waters, Ambon Bay. Triton: Journal of Aquatic Resources Management, 16(1), 1-7.
Tunali, M. M., Myronyuk, O., Tunali, M., & Yenigün, O. (2022). Microplastic abundance in human-influenced soils in recreational, residential, and industrial areas. Water, Water, & Soil Pollution, 233(11), 433.
Yona, D., Zahran, M., Fuad, M., Prananto YP, & Harlyan, L. (2021). Microplastics in Waters: Types, Sampling Methods and Laboratory Analysis. UB Press.
Yu, Q., Hu, X., Yang, B., Zhang, G., Wang, J., & Ling, W. (2020). Distribution, abundance and risks of microplastics in the environment. Chemosphere, 249. https://doi.org/10.1016/j.chemosphere.2020.126059