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Initial investigation of microplastic pollution in river sediments at Yogyakarta City Indonesia
1. Introduction
As the capital of the Special Region of Yogyakarta, Indonesia, Yogyakarta City has the highest population density in the province, namely 13,007 persons per sq km (BPS Sleman, 2019). The desenly populated settlements at the river border make the three main rivers in Yogyakarta City, Winongo River, Code River, Gadjahwong River, polluted from sewage and household and industrial waste (Sarengat et al., 2015; Putro, 2016; Muryanto et al., 2019). Around xx359.1 tons of waste per day are generated by Yogyakarta City residents, where 39.3% is waste from plastic polymers (Cadman et al., 2018). According to Mehlhart & Blepp, 2012, around 90% of plastic waste in rivers comes from residential land activities. Garbages consisting of packaging bottles, single-use plastics, diapers, and used clothes, stagnate in the three rivers (Tribun Jogja, 2018; Utami & Putri, 2019).
Plastic waste floating in the water will be fragmented by sunlight (photodegradation), oxidation, and mechanical abrasion to be microplastics with a size of ≤ 5 mm (Thompson et al., 2009). Pieces of microplastics ingested by living things can cause physiological disorders to be carcinogenic (Wright et al., 2013; Vendel et al., 2017). Microplastics come from primary sources such as microbeads or pellets that are deliberately made in microscopic sizes in the cosmetic industry (Boucher & Friot, 2017) and comes from secondary sources such as fragments, films, fragmented fibers from macro plastics (Cole et al., 2014; GESAMP, 2016). The size range of microplastics in sediment generally ranges from 1µm-5,000µm (Hidalgo-Ruz et al., 2012). The type of microplastic polymer has varied density from the lightest, such as expanded polystyrene (styrofoam) to polytetrafluoroethylene (PTFE) (Duis & Coors, 2016).
Microplastics in water bodies have been recorded to increase in the last decade, varying in characteristics by shape, size, color, and polymer (Waller et al., 2017; Lebreton et al., 2017; Alimba & Faggio, 2019). Java Island, as the most populous island in Indonesia, has been found in many microplastics in the river and sea, such as in Indah Kapuk Beach, Jakarta (Hastuti et al., 2014), Jagir Estuary Surabaya (Firdaus et al., 2020), Pangandaran Beach, West Java (Septian et al., 2018), West Coast of Karimun Besar Island (Amin et al., 2020). In Yogyakarta City, fish in the Code river have contaminated by microplastics (Sulistyo et al., 2020). The findings of these microplastics are a threat to pollution to the aquatic ecosystem in Yogyakarta. Still, there is no information on how many microplastics are in the rivers that cross Yogyakarta city. This research aimed to analyze the abundance and characteristics of microplastics in the river sediments of Yogyakarta city. The novelty of this research is the existence of microplastic data collection that has never been done by previous research. The research on river water pollution in Yogyakarta generally only detects the physical, chemical, and biological parameters contained in Baku Mutu Air (Water quality standards) regulation. Results of this study can provide necessary information on the level of microplastic pollution as initial investigation in rivers at Yogyakarta city.
2. Methodology
2.1. Research design
The research began with determining the location, sediment sampling, separating microplastics from the sediment and calculating the abundance of microplastics. The sediment sampling location was at the inlet (I) and outlet (O) points of the Winongo River (W), Code River (C), Gadjahwong River (G) within Yogyakarta City (Figure 1 and Table 1). Samples were taken from December 2019 at the end of the long dry season in 2019 (Prasetyaningtyas, 2020).
2.2. Data collection

Three sediment samples were collected randomly inside a 50x50 cm plot in each sampling point (Barasarathi et al., 2014). Sediment samples were taken using a 4-inch iron pipe with a height of 10 cm, then was stored in a glass bottle and put into a cooler with a temperature of 4 °C. (Dewi et al., 2015). The Measurement of abiotic factors, such as water flow velocity, water temperature, water pH, dissolved carbon dioxide, dissolved oxygen, and light intensity, was carried out in each sampling plot (Syranidou et al., 2017). Environmental conditions with a radius of 500 meters were recorded to document all visible pollution around the sampling point. The sediment samples were then filtered with a 5 mm mesh sieve (Hidalgo-Ruz et al., 2012) and then oven at 105˚C for 48 hours. The microplastic separation stage was carried out by mixing the dry sediment sample (1 kg) and saturated NaCl solution (3L) then the mixture was stirred for 2 minutes (Dewi et al., 2015). The supernatant containing microplastics was filtered and was identified for abundance in each shape, size, and color (Table 2). Identification of microplastics from supernatants and grouping by shape, size, and color character was carried out by visual separation method using binocular microscope, optilab, and image raster application. Microplastic abundance will be presented by particles per kilogram of dry sediment (particles kg-1) (Claessens et al., 2011).

2.3. Data analysis

This study used quantitative data analysis where microplastic abundance was analyzed descriptively and statistically. Statistical analyses were performed using SPSS 22.0 software, which was tested for normality and homogeneity to determine a parametric or non-parametric test (Utami & Putra, 2020). Furthermore, t-paired or Wilcoxon statistical tests with a significant level of 0.05 were used to test two groups of abundance data at the combined inlet and outlet of the three rivers and each river. A correlation test was also used to correlate abiotic and microplastic abundance.

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