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Microplastics Accumulation and Abundance Standardization for Fluvial Sediments: Case Study for the Tena River

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Abstract : Human dependence on plastic products has led to global pollution, with plastic particles ranging in size from 0.001 to 5 millimeters, which are called microplastics (hereafter, MPs). The abundance of microplastics is used as an indicator of pollution. However, reports of pollution (abundance of MPs) in river sediments do not consider that the accumulation of sediments and MPs depends on the energy of the river. That is, the abundance of microplastics will be underestimated if the sediments analyzed come from places where the river flows with a lot of energy, and the abundance will be overestimated if the sediment analyzed comes from places where the river flows with less energy. This bias can generate an error greater than 300% of the MPs value reported for the same river and should increase when comparisons are made between 2 rivers with different characteristics. Sections where the river flows with higher energy allow sands to be deposited and limit the accumulation of MPs, while sections, where the same river has lower energy, allow fine sediments such as clays and silts to be deposited and should facilitate the accumulation of MPs particles. That is, the abundance of MPs in the same river is underrepresented when the sediment analyzed is sand, and the abundance of MPs is overrepresented if the sediment analyzed is silt or clay. The present investigation establishes a protocol aimed at incorporating sample granulometry to calibrate MPs quantification and eliminate over- or under-representation bias (hereafter granulometric bias). A total of 30 samples were collected by taking five samples within six work zones. The slope of the sampling points was less than 8 degrees, referred to as low slope areas, according to the Van Zuidam slope classification. During sampling, blanks were used to estimate possible contamination by MPs during sampling. Samples were dried at 60 degrees Celsius for three days. A flotation technique was employed to isolate the MPs using sodium metatungstate with a density of 2 gm/l. For organic matter digestion, 30% hydrogen peroxide and Fenton were used at a ratio of 6:1 for 24 hours. The samples were stained with rose bengal at a concentration of 200 mg/L and were subsequently dried in an oven at 60 degrees Celsius for 1 hour to be identified and photographed in a stereomicroscope with the following conditions: Eyepiece magnification: 10x, Zoom magnification (zoom knob): 4x, Objective lens magnification: 0.35x for analysis in ImageJ. A total of 630 fibers of MPs were identified, mainly red, black, blue, and transparent colors, with an overall average length of 474,310 µm and an overall median length of 368,474 µm. The particle size of the 30 samples was calculated using 100 g per sample using sieves with the following apertures: 2 mm, 1 mm, 500 µm, 250 µm, 125 µm and 0.63 µm. This sieving allowed a visual evaluation and a more precise quantification of the microplastics present. At the same time, the weight of sediment in each fraction was calculated, revealing an evident magnitude: as the presence of sediment in the < 63 µm fraction increases, a significant increase in the number of MPs particles is observed.

Keywords : microplastics, pollution, sediments, Tena River
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