ABSTRACT

Despite growing awareness on microplastics (<5 mm) pollution in the environment, effective policies to facilitate its mitigation are hampered by the limited availability of validated baseline information. Among the many challenges in baselining efforts, the absence of a standardized or harmonized set of methodologies has always persisted ever since the gap was acknowledged. Harmonization is important in baselining; it allows for discrete sets of data generated by different groups to be integrated to achieve a comprehensive view of the problem. In the Philippines where baselining studies are just starting to catch up, the lack of harmonization manifests through the differences in sampling, processing, identification, and data reporting protocols. This needs to be addressed to further understand large-scale processes affecting the abundance and distribution of microplastics in the natural environment. To contribute to addressing these gaps, we optimized and validated methods for extraction, control preparation, and identification of microplastics from beach sediments to investigate potentially relevant factors influencing their abundance and distribution. Specifically, this thesis touches on two main themes: (1) optimization of methods for extracting microplastics and preparing the control matrix from beach sediments through comparison studies, and (2) understanding factors potentially influencing the abundance and distribution of small microplastics (<1 mm) in beaches in Western Philippines using high throughput methods for baselining.

The first study emphasized the importance of experimental controls in quantification studies involving microplastics. Here, we showed that pre-existing contamination can be removed by subjecting the beach sediments to a furnace at 550 °C for 4 hours, which allows for its use in experimental controls. Meanwhile, extraction was best facilitated by a slightly modified Masura *et al.* (2015) protocol, which

exhibited a mean extraction efficiency of 99.05 ± 0.82% through spike-recovery experiments. In this chapter, we also discussed how harmonization can still be achieved even in consideration of the local socioeconomic context of the Philippines.

Under the second theme, we looked at high-throughput methods, specifically Nile Red (NR) staining coupled with automated image-based identification techniques, to obtain baseline concentrations of small microplastics (<1 mm; SMPs). A deep-learning based model called YOLOv5 proved to be effective in identifying NR-stained SMPs in images, which was then applied to samples extracted from beaches of the western Philippines. Population density and sediment grain size (i.e., percent gravel) were observed to significantly influence the pattern of SMPs abundance. In this chapter, we also proposed a possible mechanism by which SMPs accumulate in beach environments in the context of high-energy environments such as the strandline.

Overall, these findings directly contribute to harmonization and baselining efforts by recommending potential methodologies that can be considered for a more harmonized and efficient approach to baselining in the Philippines. This study has also demonstrated how baselines can be used to investigate the relevant factors influencing the abundance and distribution of microplastics. It is important to recognize that the scarcity of baselines, while in itself a problem, can be taken advantage of as it also presents the opportunity to harmonize at an early stage. Ultimately, harmonization aids the effective translation of insights from baselines into effective, evidence-based policies to holistically address microplastics pollution.