MASTER THESIS PROJECT

Characterization of Plastic Debris Originating from the Fishing Gears in the Bay of Biscay and Development of Advanced Spectroscopic Methodologies for Precise Quantification of Microplastics

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ABSTRACT

Abandoned, lost, or otherwise discarded fishing nets (ALDFG) account for 27% of total litter stranded on the European beaches. Given the emergence of the southeastern Bay of Biscay as a pivotal marine litter accumulation zone, the deposition of plastic on its beaches raises environmental apprehensions. Particularly worrisome is the susceptibility of these plastics to degradation and the generation of secondary microplastics due to UV radiation exposure on the beach. Notably, no comprehensive scientific publication characterized these beach depositions and studied fishing gear degradation, including quantifying produced microplastics, globally or within the Bay of Biscay's coastal region.

Therefore, this master thesis was designed to bridge this scientific knowledge gap by rigorously characterizing fishing gear debris washed up on the selected monitoring sites of the coast of Biscay throughout the seasons. A unique "Fishing gear Identification Key" chart was created to support the categorizing process. Further chemical Identification was obtained through ATR-FTIR spectroscopy. Concurrently, the development of a spectroscopic protocol to optimize the quantification and morphology analysis of microplastic particles as small as 10 µm was also implemented using laser direct infrared (LDIR) spectroscopy.

Post categorization, we found lower plastic prevalence in Gipuzkoa and Bizkaia, Spain, compared to their French counterparts, with “Trawl Mending” being the dominant fishing gear category. Winter sees higher gear occurrence, primarily comprising polyethylene and polypropylene polymers across all categories. These observations find support in existing studies, further accentuating the elevated susceptibility of the SE French Atlantic coast to plastic accumulation. Additionally, our established LDIR protocol for microplastic

quantification revealed particles as small as 3 µm for artificially aged Poly (1,4-butylene succinate) fishing nets while showcasing remarkable size distribution at the lower range. This study validates LDIR chemical imaging as a promising tool for rapid and automatic characterization of microplastic samples across a broad range of sizes, eliminating the need for visual preselection of particles during analysis.