



INSTITUTIONEN FÖR MARINA VETENSKAPER

Sources and fate of plastic particles in Northern European coastal waters

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ABSTRACT

Plastics are integral parts of our lives and have allowed for important technological leaps within society. However, an unwanted consequence of our current consumption of plastics is marine plastic pollution and in order to reduce its impact we need to understand its sources and fate patterns. It is a threefold challenge as it requires suitable methodology, as well as in-depth studies of sources and the various processes that affect the fate of plastics. Based on comprehensive tests and evaluations, this thesis provides recommendations on suitable methodologies for sampling, extraction and identification. To further improve the understanding of the fate of plastics in the ocean, *in-situ* experiments related to oxidation and biofouling were performed. Moreover, the distributions of plastic pellets were mapped in a case study area, through field studies and calculations, to understand the spread from local point sources. The results show that floating plastics are prone to beaching and it is concluded that although plastics can be subject to long-range transport, the majority of the pollutants will be found close to the point of release. The studies also show that most floating plastics will eventually sink, due to biofouling and degradation. To provide information on diffuse sources, the evaluated methods were then applied to analyze surface waters, sediment, biota and beach materials. Most microplastics (53-100%) found in the different surveys were identified as fragments of polyethylene, polypropylene and expanded polystyrene. Since most of the microplastics therefore stem from macroplastics, any attempt to address microplastic pollution needs to have a strong focus on macroplastics. Additionally, pellets and fluff were often encountered and specific point sources related to the production of plastics were examined in an interdisciplinary case study. The study showed continuous spills of plastic pellets associated with production, transportation and storage. The study furthermore illustrated that although there is a legal framework in place, it is not being adequately enforced, which has resulted in limited responsibility and accountability for the involved actors. The studies related to fate processes illustrate why attempts to decrease plastic pollution need to be focused as close to the source as possible, since that is where prevention and mitigation measures will be most efficient. Furthermore, the results from the field studies are crucial to consider for solution-oriented initiatives. They provide important insights regarding sources and fate of plastic particles, showing that in order to decrease microplastic pollution the main focus needs to be on larger plastics and how we use them. This means working actively to decrease waste streams through a lower level of consumption, while simultaneously improving waste management strategies to prevent leakage. The increasing interest from multiple stakeholders in academia, amongst policy makers and in the civil society also emphasizes the need for empirical data and clear communication to avoid discrepancies between the perceived and the actual sources and fate of floating plastic particles.

Keywords: plastic pollution, polyethylene, microplastics, fate, sources, FTIR spectroscopy, method development