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TITLE: No increase in marine microplastic concentration over the last three decades ? A case study from the Baltic Sea

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ABSTRACT:

Microplastic is considered a potential threat to marine life as it is ingested by a wide variety of species. Most studies on microplastic ingestion are short-term investigations and little is currently known about how this potential threat has developed over the last decades where global plastic production has increased exponentially. Here we present the first long-term study on microplastic in the marine environment, covering three decades from 1987 to 2015, based on a unique sample set originally collected and conserved for food web studies. We investigated the microplastic concentration in plankton samples and in digestive tracts of two economically and ecologically important planktivorous forage fish species, Atlantic herring (*Clupea harengus*) and European sprat (*Sprattus sprattus*), in the Baltic Sea, an ecosystem which is under high anthropogenic pressure and has undergone considerable changes over the past decades. Surprisingly, neither the concentration of microplastic in the plankton samples nor in the digestive tracts changed significantly over the investigated time period. Average microplastic concentration in the plankton samples was $0.21 \pm 0.15 \text{ particles m}^{-3}$. Of 814 fish examined, 20% contained plastic particles, of which 95% were characterized as microplastic (<5mm) and of these 93% were fibres. There were no significant differences in the plastic content between species, locations, or time of day the fish were caught. However, fish size and microplastic in the digestive tracts were positively correlated, and the fish contained more plastic during summer than during spring, which may be explained by increased food uptake with size and seasonal differences in feeding activity. This study highlights that even though microplastic has been present in the Baltic environment and the digestive tracts of fishes for decades, the levels have not changed in this period. This underscores the need for greater understanding of how plastic is cycled through marine ecosystems. The stability of plastic concentration and contamination over time observed here indicates that the type and level of microplastic pollution may be more closely correlated to specific human activities in a region than to global plastic production and utilization as such.

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