Chemical and ecotoxicological characterization of additives leaching from a plastics-polluted island, Lisla Lyngøyna - Norway

Adrián Jaén-Gil [1], Veslemøy Navrestad [1], Gidske Leknæs Andersen [2] and Alessio Gomiero [1],*

[1] – Norwegian Research Centre AS, Dep Climate and Environment, Norway; [2] - University of Bergen, Dep of Geography, Norway

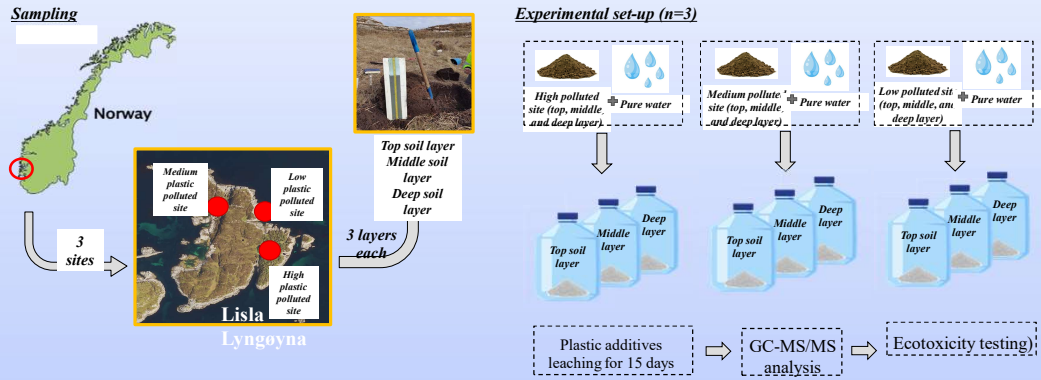
* algo@norceresearch.no

INTRODUCTION

In the last decade, the presence and environmental effects of plastic pollution in the aquatic and terrestrial ecosystems have gained special attention from the society and scientific community. Once stranded and buried, plastic waste undergoes a different type of transformations turning large plastic items into small pieces, classified as microplastics. Currently, the plastics fragmentation processes are well documented, however, little is known about plastics-associated chemicals and additive leaching phenomena, their composition, ecological effects, and environmental fate.

MATERIALS AND METHODS

The Lisla Lyngøyna island, West Coast of Norway, represents a unique "open lab" where a large amount of stranded marine litter has been buried over time and several ecological processes are still occurring. In the present study, the occurrence and environmental effects of the leachates generated from buried plastic waste have been investigated. Three soil layers have been collected at three different sampling sites containing high, medium and low plastic pollution levels. The chemical composition of the chemicals leaching from collected soil samples was analyzed using a gas chromatography system coupled with tandem mass spectrometry. For that purpose, target analysis was performed in selected ion monitoring mode for quantification of selected plastic additives as well as using isotopic internal standards. The toxicity of the leachate samples was characterized using standardized methods applied to selected testing species of key ecological value such as the crustacean D. magna, the algae *R. subcapitata*, and higher plants such as *S. saccaratum*, *L. sativum* and *S. alba*.



CONCLUSIONS

This study provides an overview of the presence and effects of plastic additives in the environment with a special focus on freshwater and terrestrial environments. Through chemical and biological studies, we evaluated the consequences of plastic as a threatening agent to the environment and the benefits of reducing plastic pollution.

RESULTS

The total presence for the phthalates leaching from both high- and medium- polluted sites was high (up to 12000 ng/mL). However, leachates from the deep layer (high polluted site) was even more contaminated than the deep layer (medium polluted site). This is due to its continuous exposure to plastic waste during decades.

The phthalate detected at the highest concentration levels in leachates were dimethyl phthalate (DMP), diethyl phtalate (DEP), and di-n-butyl phtahalate (DnBP). The low presence of Bis(2-ethylhexyl) phatalate could be explained by its higher molecular weight and very slightly solublility in water.

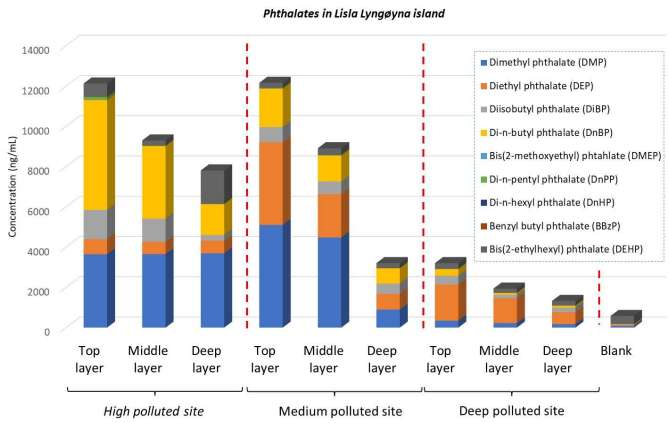


Figure 1. Occurrence and distribution of phthalates in the investigated samples

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