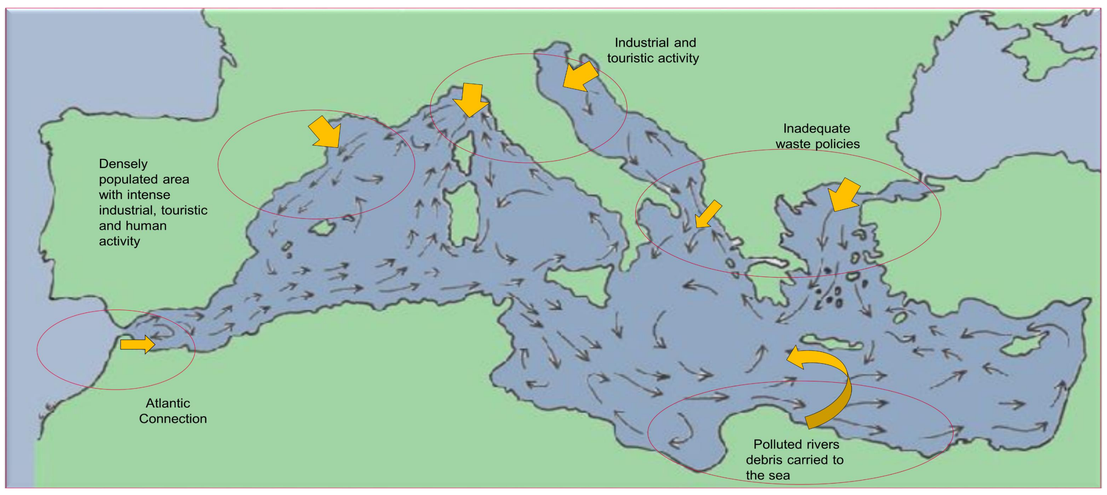
Micro- and nano-plastics pollution in Mediterranean Ecosystems – Characterization, sources and reduction guidelines.

Research Team: *Marta Schuhmacher, Jordi Sierra Llopart, Joaquim Rovira Solano, Vikas Kumar, Roberta Carafa, Jaume Folch and Nora Exposito Lorenzo*

Introduction

The microplastics can be defined as heterogeneous mixture of differently shaped materials referred as fragments, fibres, spheroids, granules, pellets, flakes or beads, in the range of 0.1 µm to 5mm. Nano-plastics size are smaller than 100 nm (0.1 µm) although some authors defined as smaller than 1000 nm (1 µm).

Every year between **70,000-130,000 tonnes** of microplastics enter to European seas [1]. The Mediterranean is considered the sixth greatest accumulation zone for marine litter: this sea holds only 1% of the world's waters, but concentrates **7% of all global microplastics** [2].



Because, of their small size, microplastics have the potential to be ingested by a wide range of fishes and bivalves, entering to the marine food chain.

The effects of human exposure to microplastics would be expected to vary depending on accumulation and translocation within edible organisms tissues. Less is known about the smaller fractions, in the range of nanoplastics which can pass more easily through cellular barriers, and in the case of higher organisms such as humans, through the epithelial tissues and enter the bloodstream reaching different tissues and organs and possibly causing damage not yet observed.

Plastic pollution may impact the biological richness and affect important biodiverse Mediterranean ecosystems (Deltas) due to organisms damages, biomagnification effects along food web. Plastic pollution can impact other sectors in the Mediterranean, especially fisheries, aqualculture, tourism, due to reduction in fish catch, damage to vessels or reduced seafood demand due to concern about fish quality, polluted beaches can also discourage visitors. Despite a big quantity of reports about microplastics impacts on a wide range of organisms, many gaps remain in understanding the microplastics fate and realistic impacts in the marine environment thus rational risk assessment should be developed.

Main Goal

This study aims to carry out an environmental and human risk assessment of micro- and nano-plastic litter in Mediterranean coastal Ecosystem.

Specific Objectives

- To determine the microplastics density, morphology, type (primary or secondary) composition, weathering ageing and origin on coastal waters, sediments, beach sand, and seafood samples.
- To identify and quantify microplastics emissions sources in coastal areas.
- To elaborate a emissions inventory and to modelate microplastics distribution in marine environments.
- To assess the toxicity of microplastics according their characteristics (i.e. morphology, size, weathering/ageing) and chemical attached or contained on it with some standard organisms..
- To assess the affinity and bioavailability of environmental pollutants (such as PAH's, HCH's and DDT) to microplastics.
- To establish the interaction mechanism of microplastics with organisms and the toxicological effects to ecosystems and human health through food web.
- To generate news strategies and tools for "*in situ*" water (seawater and freshwater) microplastic sampling.
- To use artificial intelligence for mapping shoreline microplastics pollution.
- To evaluate the municipal wastewater treatment (MWTP) system performance for microplastics removals and to propose solutions for microplastic discharges reduction to coastal areas.

Research Techniques

- Microscopy: TEM (Transmission Electronic Microscope, SEM (Scanning Electronic Microscope, Optical, Confocal, Stereoscopic AFM (Atomic Force Microscope).
- Raman Spectroscopy coupled with Confocal -Microscopy
- m-ATR-FTIR (Fourier Transformed Infrared Rays) Spectroscopy
- Fluorescence Flow Citometer
- Resonant Mass Measurement (RMM)
- GC-MS (Gas Chromatography and Mass Spectrometry)
- LC-MS (Liquid Chromatography and Mass Spectrometry)
- Toxicological Bioassays: Chronic, Subchronic and Acute test toxicity
- Modelling tools: Fate and transport models, Hidrodinamic models, (i.e. VISUALPLUMES, AGRIF-ROMS, H2Dmodel, LIMMIX, SPILL Tool, TESEO model)
- Drons

Expected results

Innovative solutions to improve the quality of coastal ecosystems and human health. New methodologies for microplastics *in situ* sampling and microplastics mapping. This results will help the policy makers, regulators entities and wastewater managers take decisions that protect the environment as: deeper polymer research and development, changes in waste and wastewater management, chemical legislation review about plastic additives and verified current overconsumption of plastic products to control their production, use, disposal, and recycling.

References

[1] European Commission. 2018. A European Strategy for Plastics in a Circular Economy.
[2] Suaria G. et al. 2016. Sci. Rep., 6,37551.

Financial support-. *This project has received funding from* ***AGAUR****: Agència de Gestió d'Ajuts Universitaris i de Recerca.* **INTERWASTE** (ETN-Horizon 2020), **DARP**, RESOLUTION ARP/619/2018