Corso di Dottorato di Ricerca in Scienze della Vita e dell'Ambiente - XXXVII

Presence, behaviour and effects of microplastic and microfiber in marine environment

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INTRODUCTION

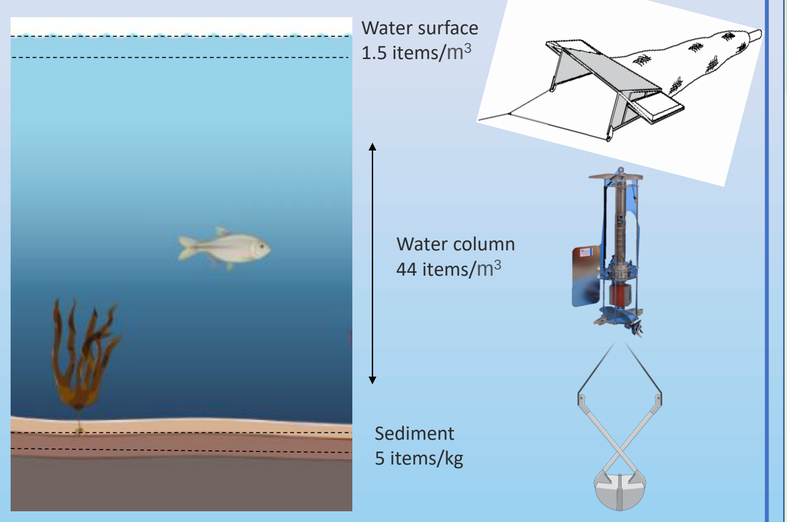
Macrophytes are key species in costal marine habitats and are widely used as indicators of water quality. These have been recently proposed as possible bioindicators for monitoring Microplastics (MPs) pollution. The ability of macrophyte to attenuate wave and reduce current velocity is potentially facilitating MPs deposition and due to their morphologies (filamentous and non-filamentous) they might work as important factors to govern MPs retention. Indeed, these particles have been detected on macroalgae blade surfaces, allowing to hypothesize their role as sink [1], either permanent or temporary, before MPs redistribution toward sediments or water column.

AIMS

Assessing the capability of algal forests to retain MPs and alter their distribution in the surrounding environment

MATERIAL AND METHODS - FIELD STUDY

Background level of MPs in the off-shore area in front of the selected study site



Background levels of MPs were analyzed in different matrices (surface water, water column, intertidal sediment) to assess the level of their presence in the Conero area (Marche region).

SAMPLING AREA

Central Adriatic Sea

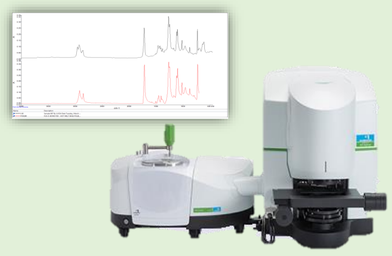
Sampling was conducted in April, May, July, October 2022 in a rocky bay of the Conero riviera (Ancona, *43.602992°N 13.5512981°E)* through snorkeling at 1m depth.

Few centimeters of the apical fronds were cut from each species and stored in ziploc bags. At the same time, sediment samples were taken, using a 50ml falcon, under the macroalgal populations and outside the algal forests ("Control").

EXTRACTION AND CHARACTERIZATION OF MICROPLASTICS

Algae were directly observed under a stereomicroscope and potential MPs were isolated.

Sediments were subjected to density separation using NaBr salt solution (1.4 g/m3) and to vacuum filtration [2]. Filters were observed under a steromicroscope for MPs isolation.



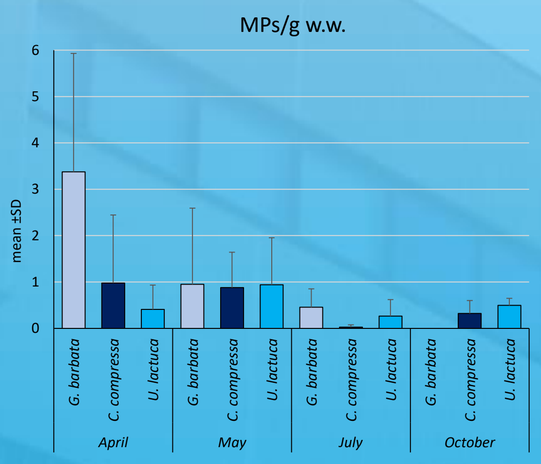
Isolated MPs were classified according to shape, size- class and polymer typologies. Chemical identification was performed through micro-FTIR spectroscopy.

RESULTS

PRESENCE OF MICROPLASTICS

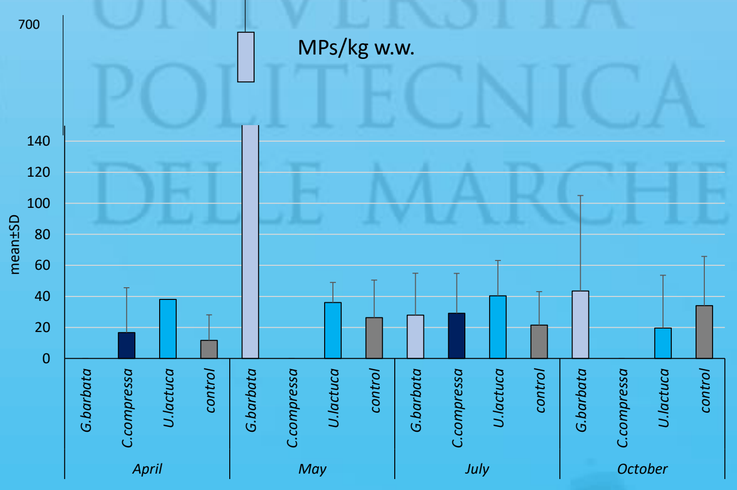
- All algal species trapped MPs with levels varying depending on the sampling period.
- *G. barbata* MPs seem to reflect its life cycle, since this species reaches its maximal growth in spring.
- Fibers were the dominant shape (98%), affecting polymer and size class composition. In fact, polyester was the most frequent polymer (widely used for synthetic textile products) and most MPs fell in the 1-3 mm size class.

ALGAE



- Sediment samples were positive to MPs with an avarage of 57.4 MPs/Kg.
- An exceptional high concentration (388 ± 224 MPs/kg) was recorded in the sediments under *G. barbata* in May.
- No MPs at all were found in the sediment below *G. barbata* in April which conversely had the highest values of MPs retention in their fronds.
- The samples of the control station showed no significant differences with those sampled below the algal population.
- Comparing sediment MPs with those found in algae:
  - fragments were detected only in sediments
  - the 0.1-0.3mm size class was missing
  - polyethylene was found only in sediments

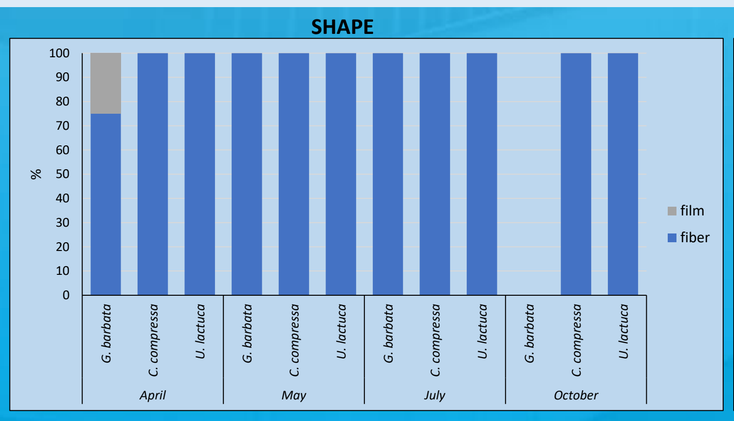
SEDIMENTS



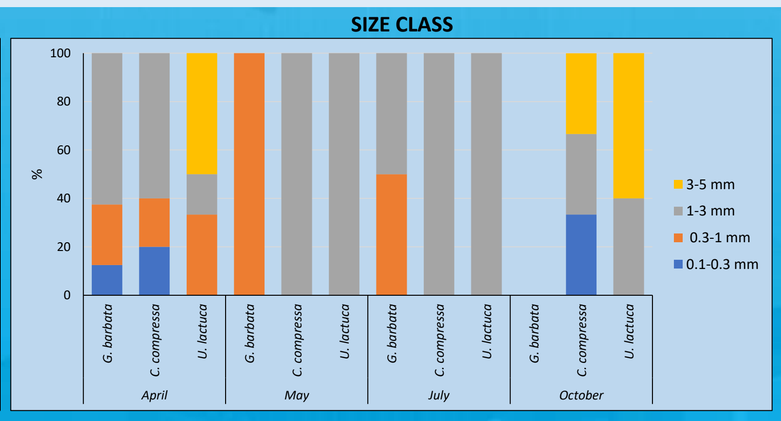
CHARACTERIZATION OF MPS IN ALGAE

ALGAE

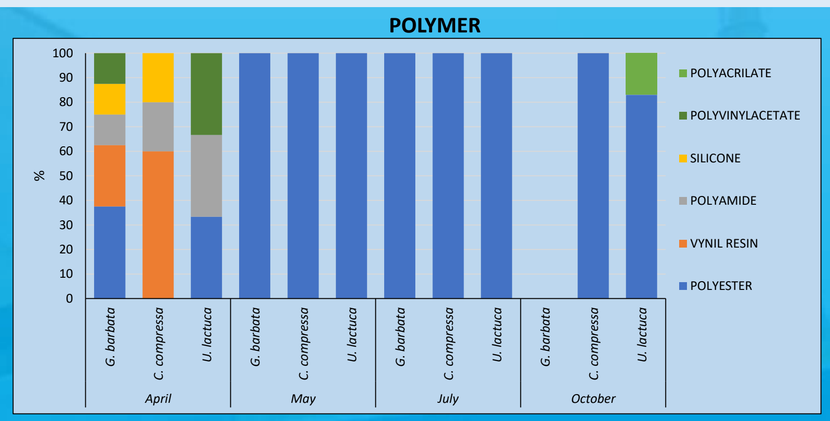
SHAPE



SIZE CLASS



POLYMER



CONCLUSIONS

In conclusion, the obtained results confirm that, according to their morphology and life cycle, macroalgae can work as sinks for microplastic particles. Despite that, no significant effect of algae in modulating the accumulation of MPs in the sediments has been highlighted.
This study underlines the importance of applying a multi-matrix approach that takes into consideration both biotic and abiotic matrices, in order to obtain a general view of the presence and fate of MPs in the marine environment, highlighting the role of algal communities as bioindicator organisms to monitor microplastic pollution.

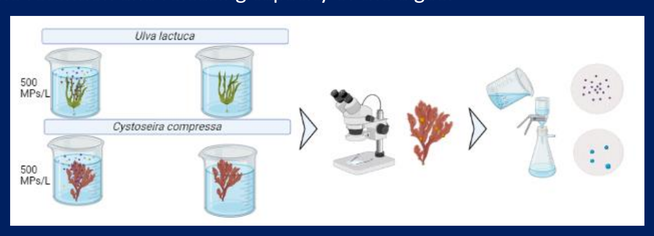
LABORATORY STUDY

Experimental Set up

In order to better understand the role of algal communities in modulating the different accumulation pattern of MPs, studies in controlled laboratory conditions were carried out.

Material and Methods

Three replicates of *Ulva lactuca* and *Cystoseira compressa* were exposed to MPs in 5L beaker. The concentration of MPs was fixed at 0.02g/L (ca 500 MPs/L) using a size rage of 250-500µm. To facilitate MPs dispersion a dispersant (Tween 20 conc. 0.01%) was added, and high bubbling was provided. Algae were submerged in the beaker and left for 1h. Depuration in a beaker with filtered sea water followed for a further hour. Algae were gently removed from the beaker and observed at the microscope. MPs were sorted out using needle and tweezers. Water was filtered and MPs were sorted out to determine the retention and releasing capacity of the algae.
Results are still in progress.



PARALLEL ACTIVITIES

- MPs detection in insects (Carabide and Onisco) as potential bioindicators for MPs in the Conero area
- Partecipation at Mesocosm experiment in the Umea Marine Science Center (Sweden), testing the effects of micronized bioplastics on clam, fish and plankton communities
- Sampling activities for the detection of tetrodotoxins (TTX) in the Conero area
- Organization of a theoretical-practical training course on MPS in the integrated water service organized as part of the European project Life Blue Lakes
- Workshops and training activities for middle and high schools

REFERENCES

[1] Gerstenbacher et al., 2022 A review of microplastic impacts on seagrasses, epiphytes, and associated sediment communities Environmental Pollution, Volume 303, 15 June 2022, 119108
[2] Frias et al., 2018. Standardised protocol for monitoring microplastics in sediments. Deliverable 4.2

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