



Interreg



UNION EUROPÉENNE
UNIONE EUROPEA



**SPLasH
&Co**

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale

PRODOTTO C.1.3-2

Progetto

SPLasH & Co

Stop alle Plastiche in H2O ai tempi del Covid



**Università
di Genova**



**EUROPEAN
RESEARCH
INSTITUTE**



**UNIVERSITÉ DE
TOULON**

ATTIVITA' C.1: PIANO DI COMUNICAZIONE

PRODOTTO C.1.3: PUBBLICAZIONI E PARTECIPAZIONE A CONVEGNI



Interreg



UNION EUROPÉENNE
UNIONE EUROPEA

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale



**SPLasH
&Co**

PRODOTTO C.1.3-2

SOMMARIO

<i>Descrizione del prodotto</i>	1
<i>Description du produit</i>	1
1. PUBBLICAZIONE SCIENTIFICA SU MARINE POLLUTION BULLETIN	1
2. PARTECIPAZIONE A CONGRESSI	3



Interreg



UNION EUROPÉENNE
UNIONE EUROPEA

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale



SPlasH
&Co

PRODOTTO C.1.3-2

Descrizione del prodotto

SPlasH & Co ha partecipato a convegni, workshop e conferenze nazionali e internazionali e ha prodotto pubblicazioni scientifiche su riviste internazionali.

Description du produit

SPlasH & Co a participé à des symposiums, ateliers et conférences nationaux et internationaux et a produit des publications scientifiques dans des revues internationales.

1. PUBBLICAZIONE SCIENTIFICA SU MARINE POLLUTION BULLETIN

A Luglio 2023 è stato pubblicato un secondo articolo, dal titolo *Biofilm-induced effect on the buoyancy of plastic debris: An experimental study* sulla rivista internazionale Marine Pollution Bulletin (n. 193, 115239) che descrive i risultati sui test realizzati in laboratorio sull'effetto del *bio-fouling* sul comportamento che le microplastiche hanno lungo la colonna d'acqua, aumentando o diminuendo la velocità di risalita verso la superficie o di sedimentazione verso il fondo.



Interreg



UNION EUROPÉENNE
UNIONE EUROPEA



SPLasH
&Co

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale

PRODOTTO C.1.3-2

Marine Pollution Bulletin 193 (2023) 115239



ELSEVIER

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul



Biofilm-induced effect on the buoyancy of plastic debris: An experimental study

Paula Núñez^{a, *}, Cristina Misić^b, Laura Cutroneo^b, Marco Capello^b, Raúl Medina^a, Giovanni Besio^c

^a IHCantabria - Instituto de Hidráulica Ambiental de la Universidad de Cantabria, Santander, Spain

^b Dipartimento di Scienze della Terra, dell'Ambiente e della Vita, Università degli Studi di Genova, Corso Europa 26, 16132, Genoa, Italy

^c Dipartimento di Ingegneria Civile, Chimica e Ambientale, Università degli studi di Genova, Via Montalegno 1, 16145 Genoa, Italy

ARTICLE INFO

Keywords:

Plastic debris
Marine pollution
Biofouling
Plastic-debris buoyancy
Terminal velocity

ABSTRACT

Plastic floating on the ocean surface represents about 1 % of all plastic in the ocean, despite the buoyancy of most plastics. Biofouling can help to sink debris, which could explain this discrepancy. A set of laboratory experiments was conducted to investigate biofilm-induced effects on the buoyancy of different plastic debris. Ten materials of different densities (buoyant/non-buoyant), sizes (micro/meso/macro), and shapes (irregular/spherical/cylindrical/flat), including facemasks and cotton swabs, were evaluated. Biofilm was incubated in these materials from a few weeks to three months to investigate the effect of different growth levels on their buoyancy. Biofilm levels and rising/settling velocities were measured and compared at seven time-points. The results show a hindered buoyancy for solid materials, while hollow and open materials showed the opposite trend in early biofilm colonization stages. A relationship was established between biofilm-growth and equivalent sphere diameter that can be used to improve predictive modeling of plastic-debris transport.

Acknowledgements

This work was funded by the European Regional Development Funds (Interreg Maritime IT FR program) under the SPLasH & Co project (contract number D35F21002010001). The first author was supported by a Margarita Salas Postdoctoral Fellowship funded by the European Union-NextGenerationEU, Ministry of Universities and Recovery Transformation and Resilience Plan, through a call from the University of Cantabria and the Government of Cantabria through the Fénix program.



Interreg



UNION EUROPÉENNE
UNIONE EUROPEA

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale



SPLasH
&Co

PRODOTTO C.1.3-2

2. PARTECIPAZIONE A CONGRESSI

Il personale dell'Università di Genova e dell'Università di Tolone ha partecipato a diversi congressi internazionali, illustrando i principali risultati ottenuti dal progetto ad un pubblico appartenente al mondo scientifico.

Irene Geneselli ha partecipato alla 9th International Conference on Sustainable Solid Waste Management a Corfù (Grecia) dal 15 al 18 Giugno 2022 con un poster dal titolo *"Monitoring, simulation, and dissemination: the European SPLasH! project strategy to face up the microplastic problem in commercial port environment"*.





Interreg



UNION EUROPÉENNE
UNIONE EUROPEA



SPLasH
&Co

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale

PRODOTTO C.1.3-2

Monitoring, simulation, and dissemination: the European SPLasH! project strategy to face up the microplastic problem in commercial port environment

L. Cutroneo¹, G. Besio², F. Borgogno³, S. Canuto³, S. Consani⁴, A. De Leo², I. Forioso³, I. Geneselli^{1*}, V. Lenoble⁵, S. Mounier⁵, M. Petrillo¹, A. Reboa¹, A. Stocchino⁶, J.A. Tesán Onrubia⁵, M. Capello¹

¹DISTAV, University of Genoa, Genoa, I-16131, Italy; ²DICCA, University of Genoa, Genoa, I-16145, Italy

³European Research Institute, Turin, I-10144, Italy; ⁴DST, University of Pisa, Pisa, I-56126 Italy;

⁴MIO, University of Toulon, Toulon, F-83041, France; ⁵CEE, Hong Kong Polytechnic University, Hong Kong, ZS972, China

*Presenting author email: irene.geneselli@edu.unige.it

Introduction

The European SPLasH! "Stop to plastics in H₂O!" project is one of the many projects that have been devised in recent years for the study, monitoring and management of microplastics (MPs) in marine environments, but it is the only one (at its start in 2018) targeting the port environment. The project is a collaboration between the University of Genoa (IT), the University of Toulon (FR) and the European Research Institute (IT), and it was divided into three different activity categories: monitoring, simulation, and dissemination (Fig. 2). The aim of the project was to provide stakeholders with useful information for the implementation of measures and actions to reduce the impact of plastics on port and outside waters.



Fig. 1: Area of the Interreg ITA-FR Maritime 2014-2020 programme (in blue).

The project monitoring plan included 4 campaigns (from 2018 to 2019) in the ports of Genoa, Toulon and Olbia (Fig. 1) for the sampling of sediments, surface waters, surface MPs and fish. Sediment, water samples and fish stomatal content underwent density separation, organic matter digestion and microfiltration.

A series of laboratory experiments was performed with the aim of measuring MP trajectories under different wave conditions and according to different MP characteristics. Marine circulation and MP dispersion process were studied. The FLOW module of DELFT3D was used to simulate the multidimensional hydrodynamics. The evolution of the horizontal velocity generated on the surface of the domain and the evolution of the MP concentration were obtained.

Dissemination activities with schools took place and different communication tools were used.

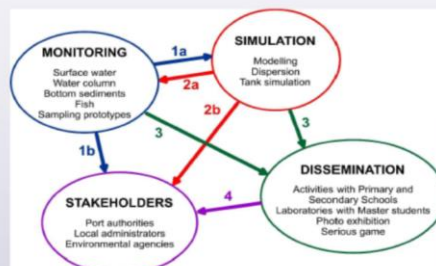


Fig. 2: The strategy of the SPLasH! project to face up the MP problem in commercial port environment. Colours represent the different activity categories addressed by the project; numbers indicate the time order in which the activities were carried out within the project.



Interreg



UNION EUROPÉENNE
UNIONE EUROPEA



SPlasH
&Co

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale

PRODOTTO C.1.3-2

Results & Discussion

Items extracted from the samples have been classified by shape, color and dimension by optical analysis, revealing a prevalence of filament and fragment shapes and dimensions of 63-500 μm . The polymeric composition of the MPs in water samples was more heterogeneous than in sediments (Fig. 3) and the MP composition was more diverse and abundant in samples taken in Genoa than in Toulon, for both matrices. Prevalent presence of polyester was highlighted in water, while sediment samples showed a major content of polypropylene particles in both sites. These results agree with the greater complexity (in terms of port activities, morphology of the basin, presence of rivers, marine traffic, etc.) of the Port of Genoa compared to the one of Toulon.

All scenarios obtained from the simulation of MP dispersion in the Port of Genoa show a mass spillage from the port area, even if with relatively low MP concentration. However, the worst scenarios are those in which there is a northern wind that invariably tends to lead to an increase in the amount of material released from the port, resulting in significant dispersion in the surrounding area (Fig. 4).

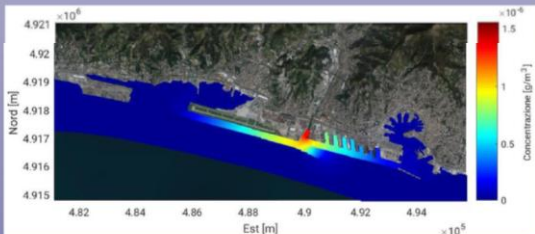


Fig. 4: Evolution of the maximum concentration of tracer released in the inner part of the Port of Genoa, with N wind.

The dissemination activity involved a total of 21 schools, 954 classes, and 1806 students from schools of different grades. The field activities made it possible to collect and catalogue 50 kg of plastic, 456 cigarette butts, 283 cotton buds. In order to broaden the vision of the problem of plastic pollution, a social game (Fig. 5) has been created and put on the net in 3 languages: Italian, French and English for its maximum dissemination.

Conclusions

The Project "SPlasH!" has been useful to better understand MPs contamination in port areas, and the results, combined with the use of dispersion models, can be exploited by Port Authorities to improve the management of this emerging environmental issue. Further sampling campaigns will be held to increase knowledge and awareness on this environmental threat during the next SPLasH & Co Project.

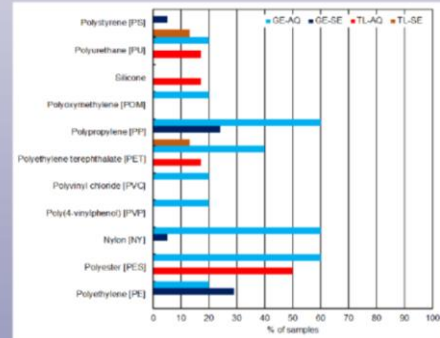


Fig. 3: Percentage of water and sediment samples from Genoa (light blue and blue, respectively) and Toulon (red and orange, respectively) containing the polymers listed on the y-axis.



Fig. 5: The SPLasH! Social game.



The present study was funded by the European Interreg Italy-France 2014-2020 Maritime projects "SPlasH! - Stop alle Plastiche in H2O!" and "SPLasH & Co - Stop alle Plastiche in H2O ai tempi del Covid"





Interreg



UNION EUROPÉENNE
UNIONE EUROPEA

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale



SPLasH
&Co

PRODOTTO C.1.3-2

Océane Lazzeroni ha partecipato al congresso IEBS 2023 a Šibenik (Croazia) dal 22 al 27 Maggio 2023 con un poster dal titolo "*Metals bioaccumulation by plastisphere and further transfer to organisms*".





Metals bioaccumulation by plastisphere and further transfer to organisms

O. Lazzeroni^{*1,2}, N. Cukrov¹, A. Barré², B. Oursel¹, R. Bunet³, J.-F. Briand² and V. Lenoble¹

¹ Université de Toulon, Aix Marseille Univ., CNRS, IRD, MIO, Toulon, FRANCE

² Université de Toulon, MAPIEM, Toulon, FRANCE

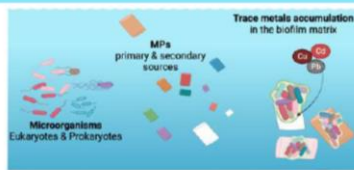
³ Institut Paul Ricard, Les Embiez, FRANCE



*Contact : oceane-lazzeroni@etud.univ-tln.fr



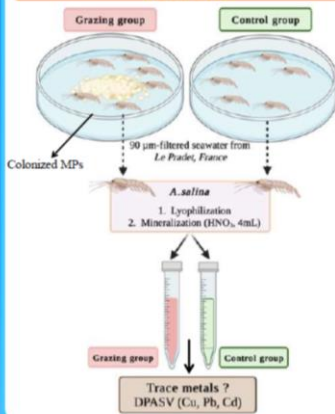
Scientific context



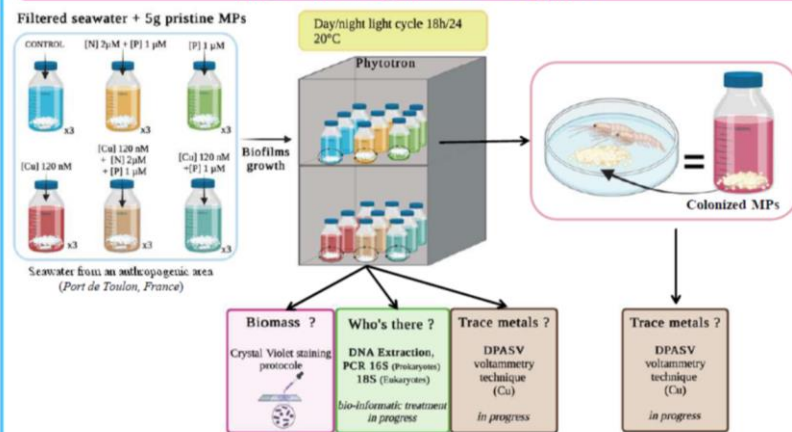
Large quantities of metals are introduced into the environment each year^[1] and coastal areas like Toulon Bay are submitted to trace metals (Pb, Cu, Cd) contamination^[2]. In aquatic environments, plastics, like any submerged object, are prone to biological colonization. Plastisphere is then defined as the microbial communities colonizing them^[3], forming a biofilm, an ubiquitous and very efficient way of preserving life^[4] at the surface of these synthetic pieces. The presence of this organic layer around microplastics was demonstrated to enhance metals bioaccumulation^[5,6]. Such bioaccumulation addresses the question of contaminants transfer to organisms. So, *Artemia salina*, filter feeder, was chosen to establish this transfer through contaminated biofilm grazing.

Experimental design

PRELIMINARY EXPERIMENT : Can trace metals bioaccumulated in biofilm be transferred to grazers ?



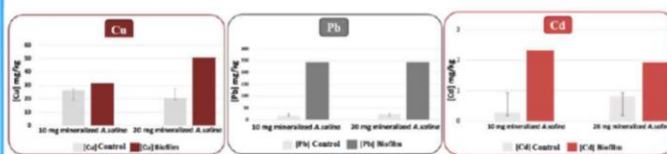
2nd EXPERIMENT : Can trace metals be differentially bioaccumulated in biofilm community with dissimilar taxa, and what consequence for transfer to grazers ?



Results

PRELIMINARY EXPERIMENT

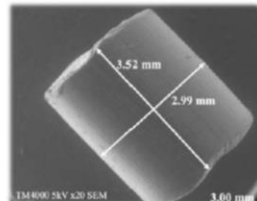
Grazing contaminated biofilm : impact on *Artemia salina*



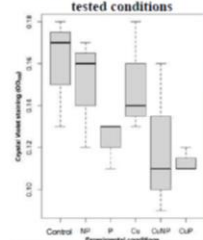
→ Accumulation of trace metals (Cu, Pb, Cd) from contaminated biofilm to *A. salina* through grazing
→ [Pb] bioaccumulation is more important than [Cu] and [Cd] ones

2nd EXPERIMENT

Virgin PS MP used for the experiments



Biomass estimation for the 6 tested conditions



→ No significant difference of the biomass estimation between conditions (p-value 0.163)

Discussion & Conclusion

- In the preliminary experiment, the DPASV procedure was adapted to switch from a seawater matrix to a biological one
- Biofilms developed *in-situ* can accumulate Cu, Pb and Cd from the surrounding sea water
- By grazing the contaminated biofilm developed around MPs, *Artemia salina* present a bioaccumulation of trace metals, suggesting a trophic transfer
- Do biofilms developed under different conditions bioaccumulate differently ? *In progress* ..
- It could be interesting to see if the trace metals are biomagnified in predators of *A. salina*

References

- [1] Callender, E. (2005). *Environmental geochemistry*, 9, 67.
- [2] Tessier, E. (2011). *Marine Pollution Bulletin*, 62(10).
- [3] Zettler, E.R. (2013). *Environ. Sci. Technol.*, 47, 7137–7146.
- [4] Flemming, H.-C. (2016). *Nature Reviews Biology*, 563-575.
- [5] Djaoudi, K. (2022). *Sci. Total Env.*, 814, 152278.
- [6] Kingopoulou, V. (2022). *J. Mol. Liquids*, 350, 118580.





Interreg



UNION EUROPÉENNE
UNIONE EUROPEA



SPlasH
&Co

MARITTIMO-IT FR-MARITIME

Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale

PRODOTTO C.1.3-2


Nusa Cukrov ha partecipato al congresso IEBS 2023 a Sibenik (Croatia) dal 22 al 27 Maggio 2023 con una presentazione orale dal titolo *"Impact of biofilm on the microplastics settling velocities"*.








IEBS 2023
XVI International Estuarine Biogeochemistry
Symposium, 23-26 May 2023, Šibenik, Croatia




IMPACT OF BIOFILM ON THE MICROPLASTICS SETTLING VELOCITIES

*N. Cukrov, A. Barré, E. Catao,
V. Lenoble and J.-F. Briand*





Interreg



UNION EUROPÉENNE
UNIONE EUROPEA



SPLasH
&Co









MARITTIMO-IT FR-MARITIME


Fonds européen de développement régional
Fondo Europeo di Sviluppo Regionale

PRODOTTO C.1.3-2

Abel Barré ha partecipato al congresso ASLO a Palma di Maiorca (Spagna) dal 4 al 9 Giugno 2023 con una presentazione orale dal titolo *"Diatoms biofilms dynamics associated to trace metals bioaccumulation on polymers along the seasons in NW Mediterranean and North Atlantic coasts"*.





Diatoms biofilms dynamics associated to trace metals bioaccumulation on polymers along the seasons in NW Mediterranean and North Atlantic coasts

**BARRE A.¹, LACERDA A.-L.², CUKROV N.³, AULANIER F.¹, PEDROTTI M.-L.²,
FRIAS J.⁴, CHIRON T.³, CASOTTI R.⁵, MUNIATEGUI S.⁶, LENOBLE V.³, BRIAND J.-F.¹**

1 - Laboratoire Matériaux Polymères Interface Environnement Marin (MAPIEM), EA4323, Université de Toulon, FRANCE
2 - Laboratoire d'Océanographie de Villefranche (LOV), UMR 7093, Institut de la Mer de Villefranche (IMEV), Villefranche-sur-Mer, France
3 - Institut Méditerranéen d'Océanologie (MIO), Toulon, France
4 - Atlantic Technological University (ATU), Galway, Ireland
5 - Stazione Zoologica Anton Dohrn, Napoli, Italy
6 - University of A Coruña, A Coruña, Spain

ASLO Aquatic Sciences Meeting 2023 - Resilience and Recovery in Aquatic Systems
SS081 JPI Oceans Joint Action: Ecological Aspects of Microplastics – From Scientific Findings to Political Action

abel.barre@univ-tln.fr

1/17