Research project and supervisor team

Supervisory Team	Dr. Enrico Marsili Dr Tania Dottorini Dr. Honglei Zhang Dr Stephan Heeb
Short introduction & description of research project	Microplastics (MP) and antibiotics are two priority seawater pollutants that enter microbial cells through several routes, e.g., protein channels in the outer membrane (Gram-negative bacteria) and diffusion in the peptidoglycan layer (Gram-positive bacteria). Due to their similar routes of entry, bacteria have developed similar responses to microplastics and antibiotics, which rely on efflux pump to decrease the pollutant concentration in the cells. Therefore, the increase of microplastics pollution is suspected to contribute to the emergence of antibiotic resistance in marine and terrestrial microorganisms, increasing the risk that this resistance might be transferred to pathogens, thus contributing to increasing antimicrobial resistance (AMR) and the associated burden on the health system. However, it is still unclear the interplay of MP-induced resistance with other antibiotic resistance mechanisms, like the biofilm formation. Our hypothesis is that, while micro- and nano-plastic (MNP) increase the risk of AMR emergence, this could happen through the biofilm modulation, and not only through direct effect on planktonic cells. In this project, we will test this hypothesis. Specifically, we will determine how the presence of MNP determine biofilm formation, microstructure and activity and how it increase the overall AMR in biofilms. In the first part of the project, we will use single species biofilm model with Gram-negative (e.g., *Pseudomonas aeruginosa*) and Gram-positive (e.g., *Enterococcus faecalis*) pathogens present in coastal environments, and determine the effect of selected MNP on biofilms structure and function via biochemical, microscopy and bioelectrochemical assays. In the second part, we will transcriptomics to measure the expression of key genes known to contribute to the AMR in presence and absence of MNP. In the third part, we will work on mixed species biofilm, assembled from model biofilm-forming microorganisms used in the project, and on mixed microbial consortia from coastal seawater in the Ningbo area. In the fourth part, we will determine how photocatalytic process, which degrade partially MNP, contribute to the AMR in environmental mixed microbial consortia. This project will contribute clarifying the mechanism of MNP-related AMR in realistic microbial communities (i.e., biofilm rather than planktonic cells) and inform the design of novel photocatalytic MNP degradation processes that can minimize the emergence of AMR in environmental biofilms. The proposed supervisors have the right expertise and resources for the project. This project has the potential to start a new research area at UNNC, which will concern the dynamic of AMR in response to novel pollutants and the risk of horizontal gene transfer to human pathogens.
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