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► **To cite this version:**

Patricia Licznar, Yen Vo Hoang, Pascaline Dieudé, Fabien Aujoulat, Patrick Monfort, et al.. Plastics and antimicrobial resistance of bacteria in coastal waters. International Symposium of LabEx DRIIHM 2022, Jun 2022, Nantes, France. , 2022, 10.34972/driihm-040f80 . hal-03716551

HAL Id: hal-03716551

<https://hal.science/hal-03716551>

Submitted on 7 Jul 2022

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Plastics and antimicrobial resistance of bacteria in Mediterranean coastal waters



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Context and questions

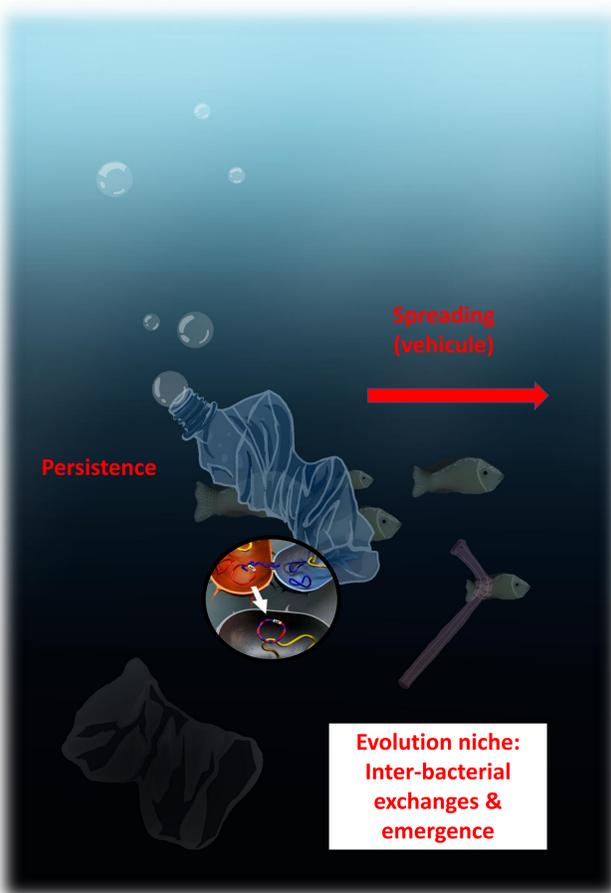
Plastisphere = ecosystem of microbes on plastic debris

Around the globe, plastic wastes are expanding (1.5 million tons produced in 1950 versus 360 in 2019), with 5 to 12 tons ending up yearly in aquatic environments (freshwater or seawater). These wastes are varied in size (microplastics or macroplastics more than 5 mm), composition and quantity.

The 2 projects **PlanB** and **Parbel** aim to explore the plastisphere and its role as a **potential hot spot leading to emergence and spreading of pathogenic and antimicrobial resistant bacteria**.

- Do macroplastics constitute reservoirs for persistence of antimicrobial resistance genes (ARGs) and for antimicrobial resistant bacteria (ARB)?
- Do they form a privileged evolution niche (genetic exchange sites)?
- Do chemical characteristics of plastics, salinity or the presence of heavy metals in water impact antimicrobial dynamics?

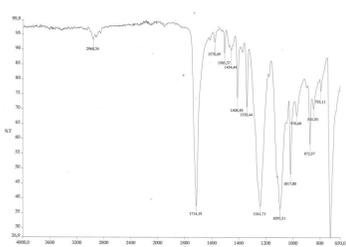
One supplementary aim will be to study the behavior of populations living near the Mediterranean coasts and to evaluate how to limit the impacts of anthropic activities on plastic pollution.



Plan B Project: Plastisphere and Antimicrobial resistance in freshwater Methodology optimization

Plastic analysis:

- Optimization of the characterization of plastics by infrared spectroscopy
- Creation of a database



Example: spectra of Ethylene Polyterephthalate (PET)

Cultivable bacterial communities analysis:

- Heterogeneous total flora
- Bacteria identification (including enterobacteria) showing phenotypic profile of resistance to clinical antibiotics.



Research of ARGs on biofilms (and water):

	Endemic resistances			Emerging resistances		
	<i>bla_{SHV}</i>	<i>bla_{TEM}</i>	<i>bla_{CTX-M}</i>	<i>bla_{OXA}</i>	<i>bla_{KPC}</i>	<i>bla_{NDM}</i>
water	-	-	-	-	-	-
Experimental device 1	-	-	-	-	-	-
Experimental device 2	-	-	-	-	-	-
Experimental device 3	-	-	-	-	-	-
Experimental device 4	+	-	-	-	-	-
Experimental device 5	-	-	-	-	-	-
material 1	-	+	-	-	-	-
material 2	+	+	-	-	-	-
material 3	+	+	-	-	-	-
material 4	-	+	-	-	-	-
material 5	-	+	-	-	-	-
material 6	-	+	-	-	-	-
material 7	-	+	-	-	-	-
material 8	-	-	-	-	-	-
material 9	-	-	-	-	-	-
material 10	-	-	-	-	-	-
material 11	-	-	-	-	-	-
material 12	-	-	-	-	-	-
material 13	-	-	-	-	-	-
material 14	-	-	-	-	-	-
material 15	-	-	-	-	-	-

Experimental devices, controlled immersion duration in urban river

Plastics removed from urban river



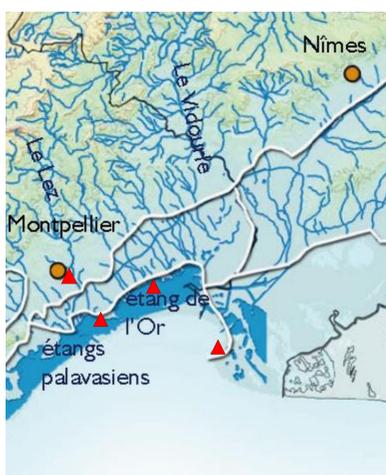
Researches to be conducted to:

- Differentiate the natural antimicrobial resistances (often water native bacteria) and transferable resistances
- Establish the link between ARGs / ARB and the nature of plastic debris.

Parbel Project: Plastics and Antimicrobial resistance in coastal waters and watershed

OHM Littoral méditerranéen study sites:

- Aigues Mortes Gulf and Lez watershed:



▲ Study Sites

- Biguglia lagoon:



Expected results: This study is conducted at the interface between environmental ecology, chemistry and public health. It will allow a better knowledge of antimicrobial resistance spreading conditions and a better understanding of the impacts of macroplastics on microbial ecology and public health.

Moreover, studying macroplastics could be used as sensitive markers of public health risks. Indeed, this information would help as a supplementary argument:

- To persuade local public services and decision makers to improve the sites cleaning and the waste sorting and recycling;
- To convince national stakeholders to limit plastic production, to support the reuse of plastics (circular economy) and to incite the use of non-plastic materials;
- To inform the population on the risks of plastic pollution and to adopt a ethical behavior.