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Authors:

Marina Maritati

Clara Revue

Malta-based scientists test environmentally friendly anti-biofouling coatings based on mussels' behaviour to avoid marine pollution

The growth of microorganisms, algae and animals on the surface of structures in contact with water, known as biofouling, damages boats and marine infrastructures and requires control actions to preserve their integrity.

Most of the removal actions involve the use of biocides and antifouling coatings containing toxic components. These chemicals contaminate the water column and enter the trophic web. This means that toxic compounds used to prevent organisms from ruining marine structures and equipment have the potential to end up in the fish we eat. An example of these toxic compounds used in the past is tributyltin (TBT). This marine biocide commonly used for its anti-biofouling property is very toxic and scientists found that it accumulates in the organisms' tissue, and it can disrupt the endocrine system. Due to its toxicity, the European Commission Parliament banned TBT in 2004. Following this regulation, new antifouling products were developed using other biocidal materials such as coatings containing copper oxide. However, these alternative coatings used worldwide still show several forms of toxicity on not-targeted marine organisms.

A research project focusing on the development of environmentally friendly and cost-effective new antifouling coatings, was funded in 2021 by the MarTERA - ERA-NET Cofund on Marine Technologies. The project is called PRONICARE (transnational cooperation for protecting niche areas from marine corrosion and biofouling by green coatings and new testing technologies) and it's a joint effort of 6 partners from Norway, Germany and Malta. The company leading the project, SINTEF AS, together with Bioenvision, the Alfred Wegener Institute, Ankron Water Service, Bioenvision, and the Maltese consultancy firm AquaBioTech Group, are collaborating to develop a sustainable thin coating with functional antifouling and anti-corrosion additives made with high-tech nanomaterial-based formulations. The consortium will assess the performance of the new coatings and their environmental impact.

AquaBioTech Group is playing a major role in the project by testing the effectiveness of the newly developed anti-biofouling coating. Scientists working for the company are testing the toxicity of the new formulations on different marine organisms. Some organisms utilised in the study are simple species, like bacteria, algae and microcrustaceans that are involved in the first stages of the biofouling process (microfoulers). But the scientists are also testing the newly developed products on more complex species that intervene in the later stages of biofouling (macrofoulers). One of these organisms is the marine mussel *Brachidontes pharaonis.* Native of the Red Sea and Indian Ocean, this mussel has now widely diffused in the Mediterranean via the Suez Canal, and it is often found infesting marine structures.

Mussels have a characteristic byssus thread, a protein filament that allow the individuals to attach to different substrates. Under the effect of pollution and environmental toxicants, the byssus production can decrease or cease, and the attachment to the substrate can be weakened. This compromises the resistance of the mussels to the action of wave and predators.

AquaBioTech Group is investigating how different coatings developed by PRONICARE partners, decrease the ability of some organisms to attach to marine structures by compromising the production of byssus. Scientists observed that, when the mussels are exposed to some coatings, the byssus production is reduced and there is a minor number of mussels attached to the surface. These results are very promising, and hopefully they will lead to development of a product that keeps boats and marine structures safe without damaging the marine environment.

The study is also contributing to understand better the mechanisms of biofouling, a very important topic investigated by many scientists around the world.

For more information on the objectives and outcomes of the PRONICARE project: https://pronicare-project.com/

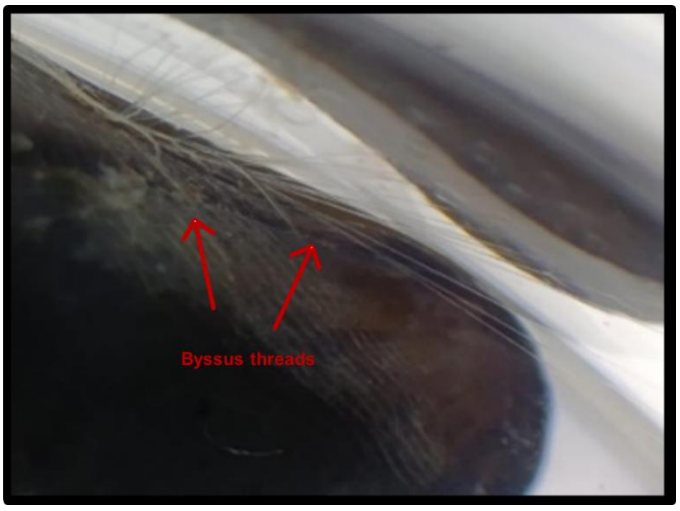
Fundings:

Project PRONICARE is funded by the MarTERA partners – Xjenza Malta, Norges forskningsråd – The Research Council of Norway, and Bundesministerium für Wirtschaft und Klimaschutz and is supported by the European Commission.

About MarTERA ERA-NET cofund:

MarTERA is an ERA-NET Cofund scheme of Horizon 2020 of the European Commission. The overall goal of the ERA-NET Cofund MarTERA is to strengthen the European Research Area (ERA) in maritime and marine technologies as well as Blue Growth. The MarTERA consortium, consisting of 16 collaborating countries, has organized joint call that is co-funded by the EU for transnational research projects on different thematic areas in 2017. Furthermore, three joint calls without co-funding by the EU have been successfully launched by the MarTERA partners in 2019, 2020 and 2021. Additional joint activities are planned, in order to contribute to the national priorities as well as to the Strategic Research Agenda of JPI Oceans and WATERBORNE. The focus of development in MarTERA is given to technologies (instead of sectors) due to their potentially large impact to a wide range of application fields.

https://jpi-oceans.eu/en/martera-era-net-cofund-marine-technologies



Detail of a mussel from an experiment performed at AquaBioTech Group (Malta). The arrows indicate the mussel's byssus threads, used to attach to hard surfaces. The coatings under development reduce the production of these structures, inhibiting the organisms' ability to adhere.

Figures to be added/re-organized within the text if needed: