15 Luglio 2025
alle ore 11.30

presso AULA 1 dell'Edificio F
Area della Ricerca CNR di Firenze
Via Madonna del Piano 10, Sesto Fiorentino

la dott.ssa Federica Bertocchini, PhD
Plasticentropy France
Reims, 51100
France
www.plasticentropy.com

terrà il seguente seminario:

" Insects and bioremediation: wax worm enzymes and plastic upcycling "

Si invitano tutti gli interessati a partecipare.

Dr. Andrea Ienco
Dirigente di Ricerca

Dr. Claudio Sangregorio
Direttore ICCOM

Short Abstract:

Plastic production continues to increase steadily, with projections exceeding one billion tons per year by 2050. The resulting accumulation of plastic waste is already causing significant environmental damage, and posing health risks to animals, including humans.

Yet, effective solutions to this urgent problem are still not on the horizon. Degradation of plastics by biological means, with recovering and utilization of degradation products, has been proposed as a potential solution for several decades. However, the use of biocatalysts for plastic waste treatment remains a major challenge, especially when targeting polyolefins. This difficulty arises from the general absence of enzymatic activities capable of breaking down these highly stable and inert synthetic materials. For decades, efforts to identify enzymes that could degrade such resistant materials have been largely unsuccessful.

Recently, however, insects have emerged as promising agents for polyolefin degradation, offering a new avenue for enzyme discovery. Notably, larvae of the lepidopteran species *Galleria mellonella*, commonly known as wax worms, have been found to produce enzymes, belonging to the phenoloxidase family, capable of oxidizing and breaking down polyethylene (PE) within just a few hours of exposure.

Could these newly discovered enzymes provide a solution for the plastic pollution crisis?

By integrating structural analysis with *in silico* studies, we aim to gain deeper insights into the enzymatic mechanisms involved in PE degradation and explore their potential applicability to other synthetic polymers.

References:

Sanluis-Verdes, A.; Colomer-Vidal, P.; Rodriguez-Ventura, F.; Bello-Villarino, M.; Spinola-Amilibia, M.; Ruiz-Lopez, E.; Illanes-Vicioso, R.; Castroviejo, P.; Aiese Cigliano, R.; Montoya, M.; Falabella, P.; Pesquera, C.; Gonzalez-Legarreta, L.; Arias-Palomo, E.; Solà, M.; Torroba, T.; Arias, C. F.; Bertocchini, F. Wax Worm Saliva and the Enzymes Therein Are the Key to Polyethylene Degradation by Galleria Mellonella. *Nat. Commun.* **2022**, *13*, 5568. https://doi.org/10.1038/s41467-022-33127-w.

Bertocchini, F.; Arias, C. F. Why Have We Not yet Solved the Challenge of Plastic Degradation by Biological Means? *PloS Biol.* **2023**, *21,* e3001979.. https://doi.org/10.1371/journal.pbio.3001979.

Spínola-Amilibia, M.; Illanes-Vicioso, R.; Ruiz-López, E.; Colomer-Vidal, P.; Rodriguez, F. V.; Pérez, R. P.; Arias, C. F.; Torroba, T.; Solà, M.; Arias-Palomo, E.; Bertocchini, F. Plastic Degradation by Insect Hexamerins: Near-Atomic Resolution Structures of the Polyethylene-Degrading Proteins from the Wax Worm Saliva. *Sci. Adv.* **2023**, *9* (38), eadi6813. https://doi.org/10.1126/sciadv.adi6813.

Biographic sketch:

F.B. is a molecular biologist by training. She obtained her PhD at the DIBIT, San Raphael Hospital, Milan, Italy, working on an intracellular calcium channel called ryanodine receptors. Afterwords, F.B. specialized in the study of early development of amniote embryos, working on basic questions related to the molecular mechanisms driving early development of chick and reptile embryos. She trained at institutes such as Columbia University, NY, USA, and University College London, London, UK. She established her own laboratory at the Spanish Research Council. While continuing her study on developmental biology questions, she developed a parallel line of research driven by the interest for environmental bioremediation by biological methodologies. F.B discovered that the larvae of Lepidoptera *Galleria mellonella* (wax worms) are capable of fast degradation of polyethylene (PE), one of the most resilient and produced plastic material in the world. Recently, in F.B laboratory the first PEases were discovered: these are enzymes produced by the larvae and capable of degrading PE within a few hours from exposure. The study of these new enzymatic activities, in view of potential future applications, together with the understanding of their role within the invertebrate physiology, constitute her current topics of research.