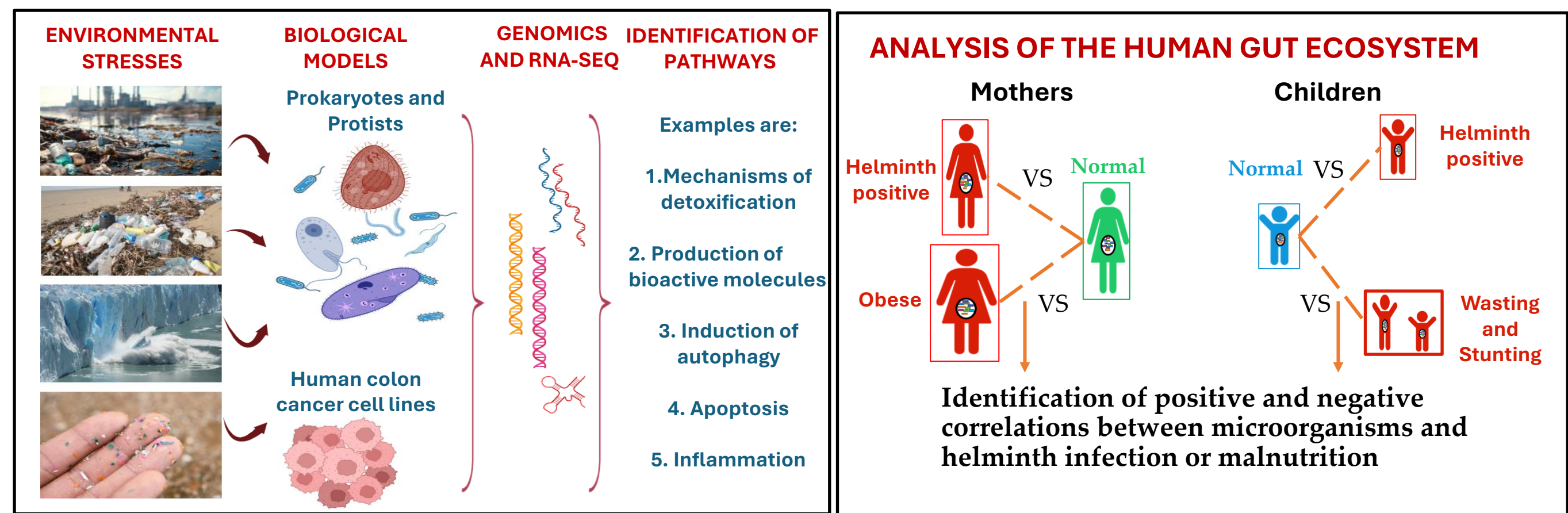


Environmental biology and microbial biotechnology to improve quality of life and environment

Authors: Cristina Miceli, Sandra Pucciarelli, Alessandra Borghi (Research fellow), Xueyan Liu (PhD candidate), Maria Chiara Biondini (PhD candidate) for **Interactions between organisms/cells and environment**; Antonietta La Terza, Martina Coletta (Research fellow), Marco Monticelli (PhD candidate), Natasha Waris (PhD candidate), Aurora Torresi (Fellow) for **Soil health assessment**; Adriana Vallesi, Claudio Alimenti for **Bioactive molecules from ciliates**; Francesco A. Palermo, Paolo Cocci, Gilberto Mosconi, Martina Capriotti (Research fellow), Valentina Mazzocchi (Fellow) for **Integrated assessment analyses of the impact of endocrine disruptors on environment and health**.

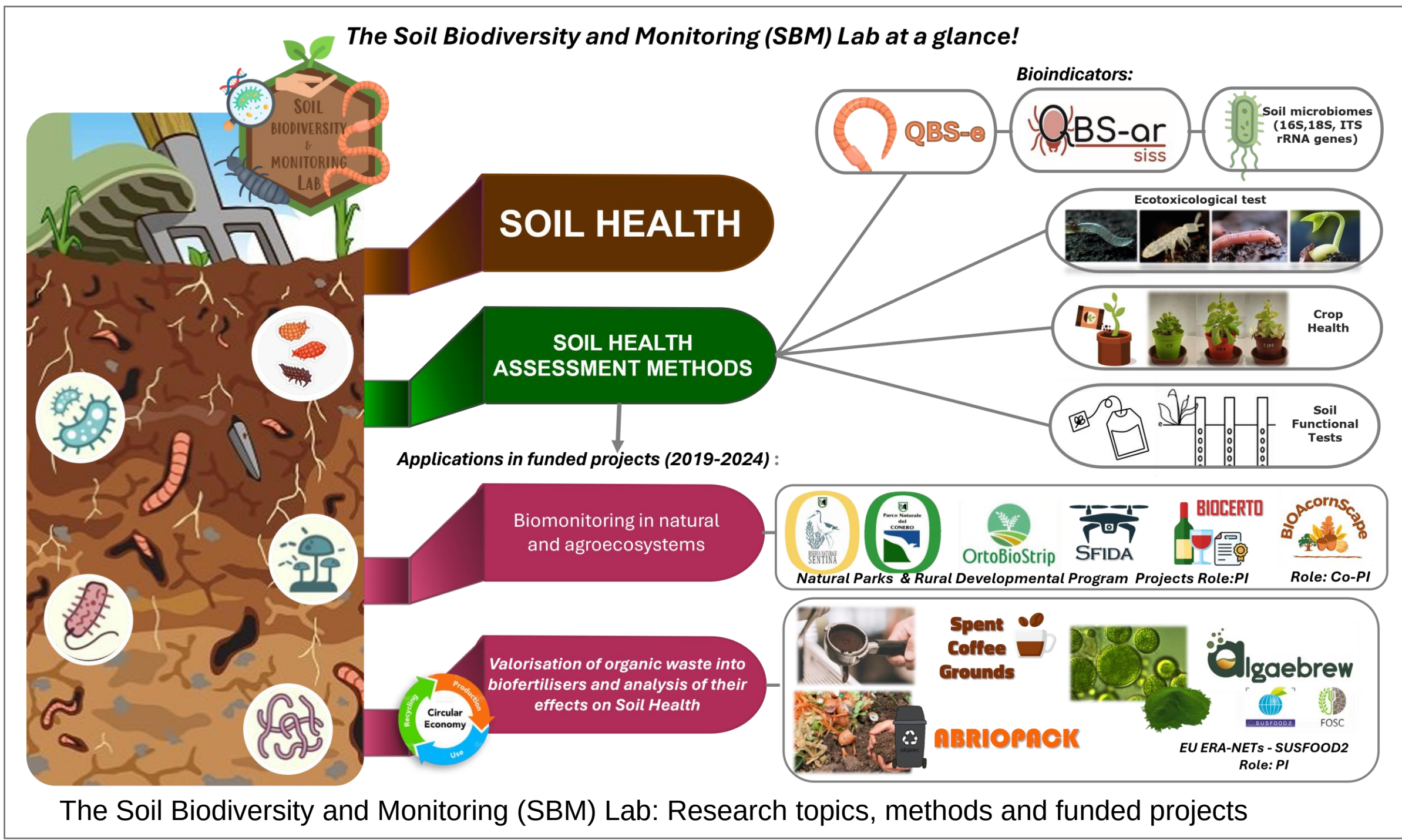
School of Biosciences and Veterinary Medicine

Core studies



Interactions between organisms/cells and environment

In recent decades, human activities have significantly increased the release of toxic substances, causing widespread environmental pollution and severe disruptions in ecosystems. This highlights the urgent need for research to understand how organisms respond to rapid environmental changes. We investigate cellular responses to environmental stresses, including temperature fluctuations and pollutants such as microplastics, nanoparticles, and derivatives, to uncover which genes and mechanisms drive adaptation, resilience, detoxification, and to identify new bioactive molecules with potential industrial applications(left panel). Additionally, we focus on interactions within the human gut ecosystem. It consists of myriads of prokaryotes and microeukaryotes that play essential roles in maintaining health and it is modulated by the environment and nutritional conditions. Attention is given to African mothers and children affected by malnutrition and intestinal parasites, aiming to propose balanced diets and probiotic supplementation for improving health (right panel). The research on stress responses has been funded by Programma Nazionale Ricerca in Antartide, PRIN-2022 PNRR, and FAR-UNICAM, and developed within international collaborations, including the University of Bern, l'Ecole Normale Supérieure in Paris, and the Chinese Academy of Science in Wuhan. The research on human gut microbiota is in collaboration with the Jilin Agricultural University (China), funded by FAR-UNICAM-China, and extended to Tanzanian research institutions in the frame of a funded Erasmus+ action on capacity building. Interactions with companies are mediated by the UNICAM SpinOff IridES(Dr. Pucciarelli is the CEO), involved in innovation for development of bioeconomy producing new bioactive molecules and biomaterials

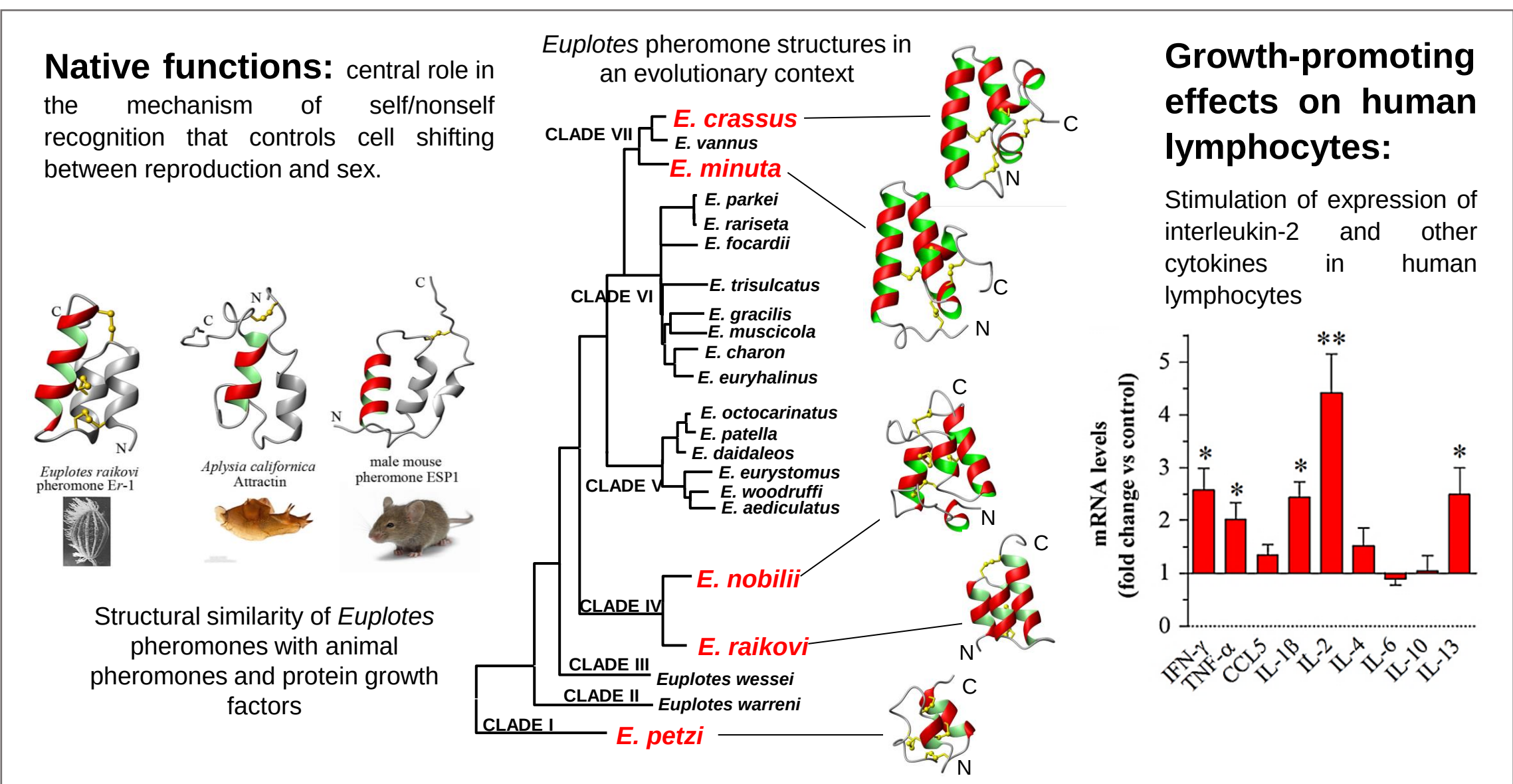
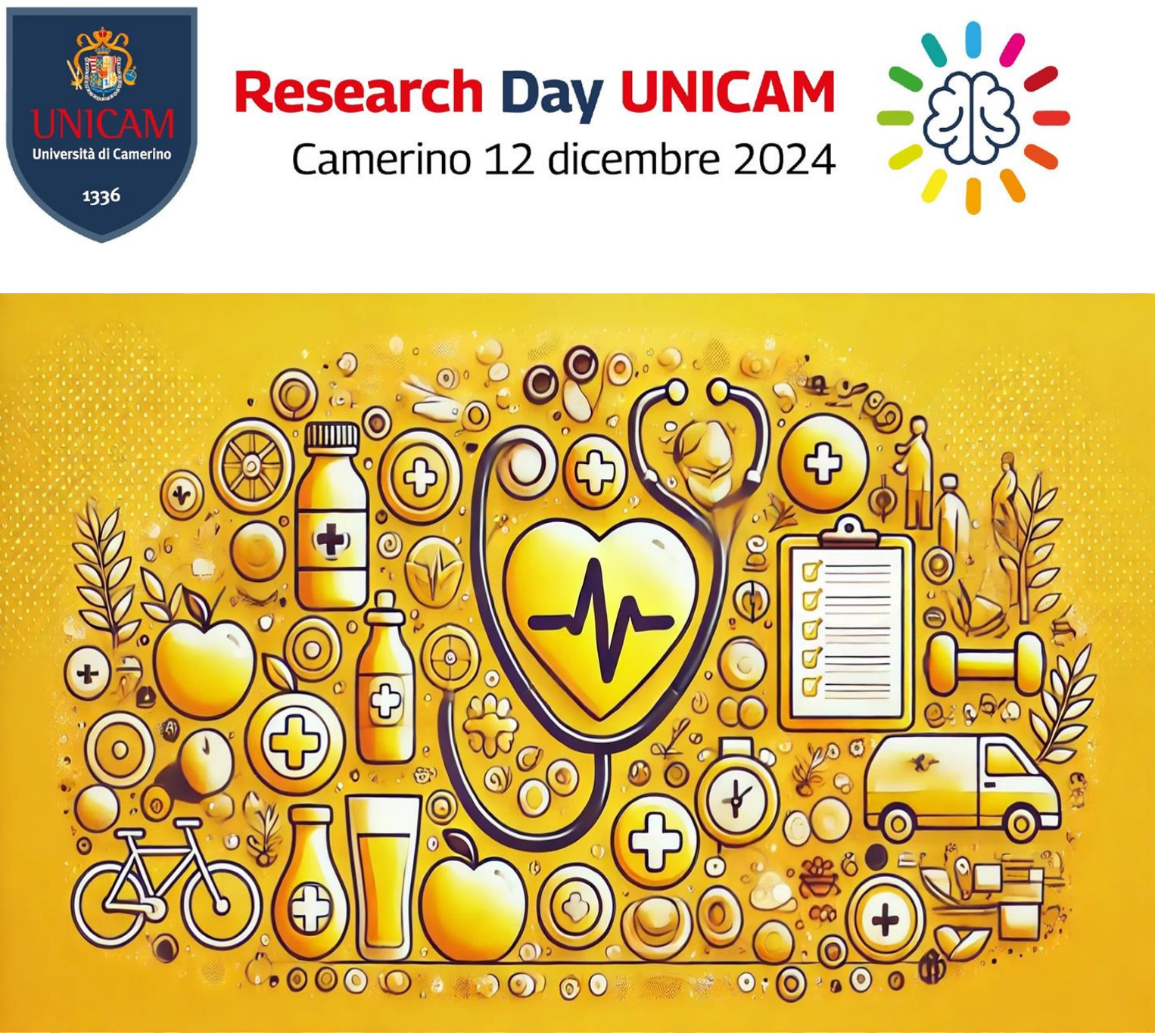


Soil Health assessment

At the forefront of the EU Commission and global policy agenda is Soil Health, which is "the continued ability of soil to function as a vital living ecosystem that supports plants, animals and humans" (NRCS, 2017). At EU level, around 60-70% of soils are unhealthy, mainly due to unsustainable agricultural practices. Human-induced soil degradation is a threat to food production and the provision of ecosystem services. In this context, the Soil Biodiversity and Monitoring (SBM) Lab investigates how ecological interactions between soil organisms and their physico-chemical environment affect critical ecosystem processes that underpin agricultural productivity and Soil Health. Recent research activities relate to the study of the structure and functional importance of the crop-associated soil microbiome using environmental DNA (eDNA). SBM activities also relate to the valorisation of organic waste into biofertilisers and the analysis of their effects on Soil Health. (See above panel)

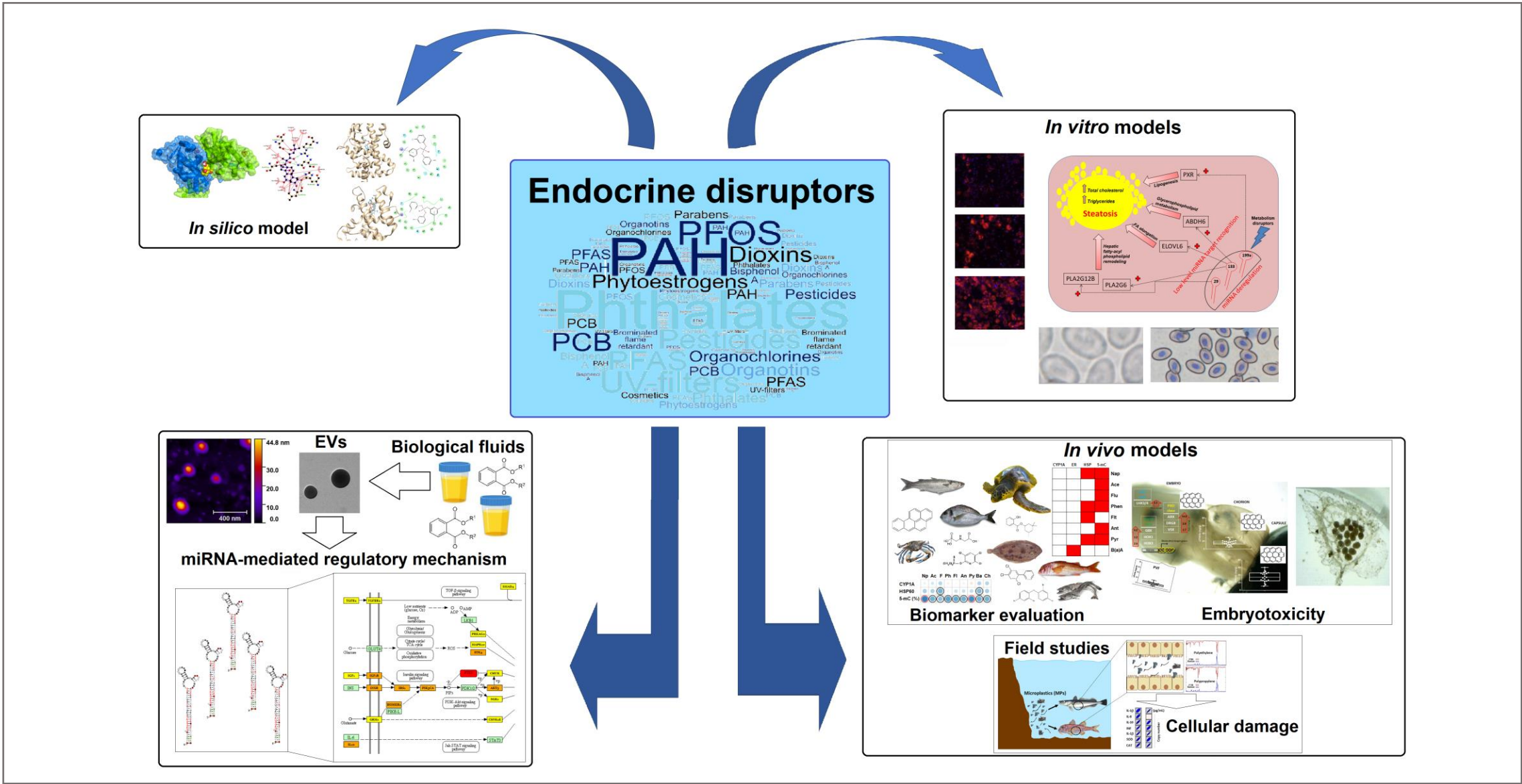
The research has been carried out or is being carried out in the framework of several international and national projects in which Prof. La Terza, head of the SBM laboratory, is or has been PI. The funding bodies are the Rural Development Programme (RDP), the Italian Ministry of Agriculture, Food and Forestry (MIPAFF), Ministry of University and Research (MUR) and the European Union (about 500K € in total) (See above panel).

The SBM Lab collaborates with companies, including Novamont S.p.a., Consorzio Italiano Compostatori, LSAQUA (BE), Natural Parks, agricultural associations. Internationally, the SBM Lab collaborates with several universities: University College Dublin (IE), Swansea University (UK), Zoological Survey of India, Western Sydney University (AU), University of Göttingen (DE), Swiss Centre for Applied Ecotoxicology, and participates in international networks: CropMicrobiome Initiative and Soil BON Foodweb Team.



Bioactive molecules from ciliates

Water-borne signaling proteins, known as pheromones, are the main focus of our research. *Euplotes* pheromones form species-specific homologous protein families, and the study of their activities has been based on the knowledge of their three-dimensional structures. These structures are the only known among the signaling proteins of the large confederation of eukaryotic microorganisms (protists). They have been first determined by NMR spectrometry (in long-standing collaboration with Prof. K Wüthrich at ETH Zurich, Nobel prize in chemistry 2002) and more recently by crystallography (in ongoing collaboration with Dr. B. Pedrini at PSI, Villingen). In a finalized perspective, *Euplotes* pheromones promise potential application in medicine and pharmacology because they have revealed exciting activities on human lymphocytes by promoting the expression of some cytokines (interleukin-2 in primis). A second line of research is centered on a new species of *Francisella* (a well-known genus containing human-noxious species of gamma-proteobacteria), isolated from an Antarctic *Euplotes*. The main interest in studying this species is understanding its potential for spreading and its harmfulness to new hosts (in collaboration with Dr. A. Sjödin, at the Swedish Defence Research Agency, and Prof. E. Villalobo, University of Sivilla). National/international collaborations: Universities of Pisa, Tuscia, Trieste, Trento; CNR Naples; MARinePHARMA Center, Pisa; Paul Scherrer Institute, Switzerland; Ocean University Qingdao China; School of Marine Sciences, Ningbo University, China; Universidad de Sivilla. Research Fundings: national competitive calls (PRIN and PNRA).



Integrated assessment analyses of the impact of endocrine disruptors on environment and health

Our research focuses on the mechanistic aspects of endocrine disruption and its effects on organisms and populations, emphasizing interactions between environmental contaminants, including emerging pollutants, and organism health. Key topics include reproduction, energy metabolism, immune function, and toxicogenomics, with studies primarily focused on marine organisms, but some involving also rodent models and humans. The group is part of the European Marine Biological Resource Centre (EMBRC) and collaborates with institutions such as the National Geographic Society, TTU and the NTNU. National partnerships include CNR IRBIM, University of Turin, Polytechnic University of Marche, terrestrial and marine protected areas (Torre del Cerrano, Sentina Natural Regional Reserve) and companies such as Blu Marine Service and BIOCHICA srl. These collaborations advance research in marine ecotoxicology, environmental endocrinology and ecosystem conservation. The research group benefits from several current (2019-2024) funding sources:

- Fisheries Local Action Group (FLAG) "Marche Sud" - "Fisheries resources: innovative actions for recovery, conservation and restocking".
- FEAMP 2014/2020 - Protection and restoration of marine biodiversity and ecosystems.
- PRIN 2022 - Environmental and health impact of PFAS associated with microplastics in a coastal area of the Central adriatic Sea (Italy) (NEOPLASTIC).
- MIPAAF - "Adriatic Chondrichthyes: development of innovative protocols for monitoring marine litter and promoting recovery, identification, conservation, and active restocking".
- RESPIRE Research Education and Storytelling Project in Italian Remote Ecosystems, funded by the National Geographic Society.