Mya arenaria in tidal flats: the role of the Holobiont in an ancient European invader (MarsH)

Director of Studies: Ulisse Cardini

Department of Integrated Marine Ecology

Seat: Genova Marine Centre, Genova, Italy

Abstract

The introduction of alien species in non-native environments is a major threat to ecosystem functioning across the globe, causing yearly damage of billions of euros to the European economy. However, the share that associated microorganisms have in the success of the holobiont (i.e., the assemblage of host and microbiome) for alien species is virtually unexplored. In this project, we explore the role of associated microbiomes in alien species invasion using the soft-shell clam *Mya arenaria* as a model organism.

M. arenaria Linnè, 1758 soft-shell clams are massive bivalves that originated in the Pacific Ocean during the Miocene and subsequently colonized Atlantic and European waters. The species later became extinct in the early Pleistocene, leaving only the Northwest Atlantic population. In the 13th century, *M. arenaria* started to recolonize northern Europe, probably transported by Viking explorers, becoming dominant amongst large clam species in the Wadden Sea. From there, the clam spread to the Mediterranean, specifically to the mudflats of the Northern Adriatic and the Po River delta, as well as to the Pacific coast of North America. This peculiar history of local extinctions, re-establishments and invasions around the northern hemisphere makes *M. arenaria* a perfect model species to explore the role of the microbiome in shaping alien species physiology, phenotypic plasticity, and colonization potential.

Therefore, this multidisciplinary project aims at answering the overarching question whether part of an alien species' command of new environments stems from their microbiome's ability to quickly change or adapt to novel environmental conditions. We will address three key questions: 1) What is the taxonomic and functional diversity of the microbiome of *M. arenaria* in the Po River delta compared to their counterparts from the North Sea, the Northwest Atlantic and the Northeast Pacific? 2) Do host and microbes display a pattern of concerted adaptive evolution along their history of local extinctions, re-establishments and invasions? 3) What is the biogeochemical imprint of the *M. arenaria* holobiont in the densely colonized habitats of the Po river delta?

To answer these complex questions, we have initiated a network of excellence at the national and international level, with a supervisory team of scientists with complementary expertise from different research institutions. We will work at the interception of microbial ecology, biogeochemistry and ecosystem ecology, from the organismal to the ecosystem levels, to constrain the role of *M. arenaria* and their microbial partners in the ecosystems they are transforming.