

### **1) Looking for the origin of the complement system in Chordates.**

Supervisor: Prof. Loriano Ballarin, e-mail: loriano.ballarin@unipd.it

The complement system is a central component of innate immunity in both invertebrates and vertebrates. In vertebrates, it provides a link between innate and adaptive immune responses. Recently, we identified the main components of the lectin and alternative pathway of complement activation in the colonial ascidian *Botryllus schlosseri*. The project aims to complete the characterisation of the complement components in *B. schlosseri*, with particular reference to the possible presence of precursors of the vertebrate lytic system and of regulatory factors. In addition, it will investigate the role of the complement in apoptosis and in the clearance of effete cells and corpses characterising the cyclical generation changes that assures the periodic rejuvenation of the colonies.

### **2) Within- and transgenerational effects of ocean acidification and other environmental stressors in marine invertebrates.**

Supervisor: Prof. Maria Marin, e-mail: maria.marin@unipd.it

There is growing concern about the capability of marine invertebrates, such as echinoderms and mollusks, to cope with environmental changes that are occurring much faster than in the past. To investigate the adaptive potential to environmental stressors, ocean acidification in particular, parents will be exposed to differing environmental conditions in both the laboratory and the field. Parental responses and offspring performances will be assessed to shed light on the presence of phenotypic plasticity and transgenerational effects.

### **3) WHY THE ONLY HUMANS? HUMAN DIVERSITY AND MIGRATION.**

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The loniness of *Homo sapiens* as last species in the genus *Homo*, a recent evolutionary event occurred around 40.000 years ago, has become a scientific question, as well as our cultural and genetic relationships with other human species. A theoretical and interdisciplinary project could be devoted to this anthropological "hot topic", on the frontline in major scientific journals, mixing molecular, ecological, paleontological and cultural data in order to figure out the patterns of human diversity and migration between 120.000 and 40.000 years ago (hybridizations, demographic competitions, waves of expansion out of Africa, material culture evolution, etc.). The APE Lab in Padua has unique features involving molecular anthropology and philosophy of evolutionary biology. The Ph.D. candidate should be able to manage (not produce) integrated data, but also to interpret them according to innovative theoretical models.

### **4) Interaction between pre- and post-mating episodes of sexual selection in a variable environment.**

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In polyandrous species, sexual selection acts both pre- and post-mating. While the scientific literature exploring these two episodes separately is vast, we are just starting to investigate how the overall variance in reproductive success can be decomposed into its pre- and post-mating components. Modifications in the strength and direction of sexual selection have important evolutionary implications (e.g. maintenance of additive genetic variation in sexual traits, genetic benefits of mate choice, adaptation to environmental changes). We will use replicated populations of guppies (*Poecilia reticulata*) to investigate how environmental and social factors affect (co)variances in mating rate and competitive fertilization success.

## 5) In cold (white) blood: speciation, introgression and hybridization in Antarctic icefish.

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Several recent examples of cryptic speciation and hybridization posit the complexity of notothenioid species. We aim at investigating these issues in the genus *Chionodraco* (Channichthyidae, Notothenioidei, Perciformes) in the Weddell Sea, the Ross Sea and the Antarctic Peninsula. The goal is to draw an overall picture of the genus *Chionodraco* in terms of distribution and genetic structure providing tools and protocols to assist the identification of species and hybrids and to be possibly applied to other Antarctic notothenioid fishes. The huge ambiguity in the morphological identification of both larvae and adults of the three species and the documented occurrence of hybrids between *Chionodraco* species pairs require that multidisciplinary tools are developed for a straightforward species identification. Several life history traits need to be considered for the three *Chionodraco* species, such as geographic distribution and otolith morphology, and related them to genetic structure and phylogeography patterns.