Evolution of molecular networks controlling the seed coat differentiation.
Supervisor: Prof. Barbara Baldan, e-mail: barbara.baldan@unipd.it

Seed formation was one of the main steps forward in the evolution of plants. The seed derives from a fertilized ovule and protects the embryo that develops within it. Since similar MADS-box genes are expressed during ovule formation in both Gymnosperms and Angiosperms, it might be possible that similar mechanisms have been recruited to regulate seed development. Contrary to Angiosperms where the model plant Arabidopsis thaliana is amply studied, almost nothing is known for Gymnosperms. In this research, a Gymnosperm (Ginkgo biloba) will be used to study the evolution of this process, focusing on the mechanisms controlling seed coat differentiation. In Ginkgo, the seed coat is particularly interesting because it develops into a fleshy fruit-like structure. Detailed transcriptome analyses will be performed to identify key regulators of seed coat development. It's becoming more evident that the expression of genes involved in the process of seed development may be regulated through epigenetic mechanisms, therefore the state of epigenetic marks on specific regulatory genes will be investigated during the early steps of seed coat formation in Ginkgo.

Immune modulation in regeneration and cell senescence in *Botryllus schlosseri*.
Supervisor: Prof. Loriano Ballarin, e-mail: loriano.ballarin@unipd.it

Main aim of the project is to shed light, at cellular and molecular level, on still unexplored links between regeneration and senescence, using colonial tunicates as model organisms. The focus will especially be on the modulatory/regulatory role played by the immune system in an organism able to perform adult regeneration. For their shorter life span, simpler organisation and genome complexity, and easier experimental use, tunicates are ideal models for elucidating those still poorly known processes that link regeneration and senescence. The comprehension of the basis of the widespread ability to promote localised senescence and rebuild the animal body found in many invertebrates is of great interest to regenerative medicine as can offer new clues to understand these biological processes and provide innovative applications for human health. Specific tasks are: 1) the study of cellular events associated with senescence/regeneration; 2) the role of the immune system in modulating senescence and regeneration; 3) the use of gene knockdown (siRNA) to study the role of some genes of interest; 4) a proteomic analysis of senescence/regeneration in collaboration with the University of Lille (F).

The use of the space by elasmobranch species in the Adriatic Sea: implication for vulnerability and insights for conservation.
Supervisor: Carlotta Mazzoldi, e-mail: carlotta.mazzoldi@unipd.it

Elasmobranchs are characterized by a complex use of space that may vary between sexes and life stages. In some species, for example, mature females actively avoid males' harassment by using different areas and sexes differ in philopatry and migratory patterns. Seasonal migrations occur in some species, and females use specific areas for parturition and/or mating. These behaviours affect population vulnerability to fishery, influencing catchability and connectivity between populations. In the Mediterranean Sea, many elasmobranchs severely declined in the last century, threatened by overfishing. This project aims to analyse the use of space of commercial elasmobranch species in the northern Adriatic Sea, with the final goal to provide the information necessary for the management of elasmobranch stocks. A multidisciplinary approach will be applied, including: analyses of fishery data, large scale tagging, survey of fishermen traditional knowledge, genetic analyses. The project will include field work on board of fishing boats, lab and computer work. Candidates are expected to have expertise in at least one of these fields of research, and be willing to learn other approaches.

Philosophy of Evolutionary Biology: Extended Synthesis and Human Evolution.
Supervisor: Telmo Pievani, e-mail: telmo.pievani@ gmail.com

The general frame of the position is philosophy of science applied to evolutionary biology. The issues will be related to the theoretical proposals, the implications and the debates surrounding the so-called "Extended Evolutionary Synthesis" and its models (i.e. niche construction, multiple sources of variation, plasticity, exaptation, bio-cultural evolution, macroevolutionary patterns). The research will focus on contemporary debates in philosophy of evolutionary biology, dissecting ideas like progress, human nature, human races, anagenetic vs cladogenetic phylogenies, mosaic evolution, niche construction in human evolution, etc. The position is indicated for philosophers of science or biologists and anthropologists with a solid training in philosophy of science and a general competence in evolutionary biology.

Sexually selected signals: understanding their evolution and variability.
Supervisor: Andrea Pilastro, e-mail: andrea.pilastro@unipd.it

Despite a central line of research aimed at quantifying relationships between reproductive success and sexually dimorphic traits (e.g., ornaments, armaments, postmating traits), individual variation in sexually selected traits often explains only a modest portion of the variation in reproductive success. One explanation may be that sexual selection is often context-dependent, i.e. by the relationship between trait expression and reproductive fitness vary along environmental gradients. Aim of this project is to explore how social environment, in particular the phenotypic composition of males and females in the mating pool, shapes the evolutionary dynamics associated with pre- and post-copulatory sexual selection, using the guppy (*Poecilia reticulata*) as a model species. The project will be in collaboration with other teams based at the University of Western Australia (Jon Evans), University of Exeter, UK (Alastair Wilson) and Doñana Biological Station (Francisco Garcia-Gonzalez). The candidate will have to possibility to spend a part of the 3-years project at one, or more of these institutions. Potential candidates are encouraged to contact A. Pilastro for further information.

Genomics of extreme adaptations to life in the Antarctic.
Supervisor: Lorenzo Zane, e-mail: lorenzo.zane@unipd.it

Which are the genetic bases of the essential traits making the life of a warm-blooded vertebrate possible in the extreme Antarctic winter conditions? We propose to address this fascinating question studying the genomic differences between the Emperor penguin, that breeds in the coldest environment on Earth, and its much less cold-adapted sibling species, the King penguin, that mates only in ice-free sub-Antarctic islands. We are carrying out a comparative whole-genome study of both penguin species to discover the signature of differential selection on relevant cold-adapted genetic traits in the Emperor penguin. This project, funded by the Italian National Antarctic Research Program (PNRA), is a collaborative study between Italian and French institutions of which the main partners are the University of Padova (Lorenzo Zane and Leonardo Congiu), the University of Ferrara (Emiliano Trucchi and Giorgio Bertorelle), and the CNRS-UniStra, Strasbourg, France (Celine Le Bohec, project leader of the program IPEV 137 of the French Polar Institute). The candidate must then be willing to spend a substantial part of his working time at these institutions. As a benefit, the PhD student will be part of a stimulating international and interdisciplinary network gaining the necessary expertise on population and adaptation genomics at the Italian partner and on ecological and physiological aspects at the French one. The latter will also offer the PhD student a unique opportunity, together with the logistic support, for a direct sampling experience in Antarctic and sub-Antarctic territories.