



Epigenetics and adaptive evolution

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Scientific objectives

The Anthropocene is characterized by rapid anthropic changes in ecosystems. Wild and cultivated species are now living in environments changing at a rate never encountered during their evolutionary history. Their future survival and agronomic performance depend on their capacity to mount evolutionary responses fast enough to cope with new abiotic stress (e.g. climate change) and biotic stress (e.g., predation, pathogens). Adaptation to these environments relies on the generation of heritable phenotypic variants. Classically it is assumed that the origin of such heritable variants result from (small and slow) changes in DNA sequence. However, it is clear now that heredity involves more than the sole transmission of the DNA sequence. The ubiquity of non-genetic inheritance affects fundamental science (the whole of biology, evolutionary biology and ecology) and applied science (medical, conservation, agronomy etc). Among different forms of non-genetic inheritance, the epigenotype and its systemic interaction with the genotype has attracted considerable research interest in the last years. While the genotype of an organism refers to its basic DNA sequence, the epigenotype refers to heritable changes in gene function that is not conveyed by DNA sequence changes. Bearers of epigenetic information are chemical modifications of that DNA and associated proteins, such as DNA-methylation, covalent histone modifications (e.g. methylation, acetylation) but also non-coding RNA and chromatin architecture. At the individual and cellular levels, the epigenotype is mitotically and to some degree meiotically heritable, but unlike in the genotype, changes in the epigenotype are reversible. We see the relation of genotype and epigenotype as an inheritance system in which the two mutually dependent elements (and potentially other) are interconnected by forward and reverse interactions, and generating as a system heritable phenotypic traits.

The objective of this research axis is to elucidate the relative importance of genetic and epigenetic inheritance and their type of relations in rapid adaptive evolution. We have a particular (but not exclusive) interest in animal parasite/symbiont – host interactions. One central question is how parasites/symbionts can produce molecular, morphological and behavioral variants that allow for overcoming infection barriers. On the host side, we focus on memory capacities of “trained immunity” a process defined as the epigenetically-driven rewiring of the transcriptional programs of innate immune cells, leading to an enhanced antimicrobial response.

Reconciling the scientific community towards a new concept in which genetic and non-genetic inheritance contribute to adaptation requires understanding the nature and origin of their interactions, and to study its molecular bases.

Link to Major Themes of Research of TULIP

This project essentially falls into MTR2 “Interactions organisme-organisme” but having strong links to MTR3 “Effet de l’environnement sur les interactions organisme-organisme” and providing empirical results for and profiting from concepts developed in MTR5 “Vers une théorie unifiée des interactions”.

Working forces involved in the project

6 ETP, 5 non-permanent staffs