EVOLUTIONARY ECOLOGY

EVOLUTION, BEHAVIOUR, ADAPTATION GROUP

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It is not the strongest of the species that survives, or the most intelligent ; it is the one most capable of change

Mots clés: Plasticité phénotypique, Biologie de l'invasion, Température, Drosophila

News

https://genestogenomes.org/in-memoriam-jean-r-david-1931-2021/

Phenotypic plasticity and adaptive responses to environmental change

My research work has allowed me to explore different aspects concerning the adaptive responses of organisms to environmental changes, mainly temperature, on the insect model and especially on Drosophila through a comparative approach. I was particularly interested in phenotypic plasticity which can be defined as the ability of a genotype to produce different phenotypes according to environmental conditions. Phenotypic plasticity is a phenomenon that can be generalized to all living organisms and that can be found in all species and for a wide variety of phenotypic traits.

The main questions addressed during my research are :

How to analyze the shapes of non-linear reaction norms? Do these reaction norms present genetic variability? How do these norms evolve between populations and between species? Do these comparisons provide arguments for adaptive phenotypic plasticity?

How will environmental variability (thermal fluctuation) impact the shape of response norms? What about environmental complexity (combination of several factors)?

What is the importance of phenotypic plasticity as a response mechanism to environmental perturbations?

Drosophila suzukii: a recent biological invasion and a major economic threat

For the past few years, my research activity has focused on a project concerning a very recent biological invasion event involving a fruit crop pest, Drosophila suzukii. At the fundamental level, we were first interested in the ecological factors that explain the invasive success of this species whose biology was poorly known. We showed that French larval parasitoids were unable to control D. suzukii populations because of its very high immune resistance capacity. We also showed that this species has a very wide range of wild host plants present throughout the year and we highlighted an interesting case of self-medication in D. suzukii. Moreover, our results suggest that if D. suzukii does not really have competitors on healthy fruits, it can undergo a strong larval competition with D. melanogaster on rotten fruits on which an oviposition avoidance behavior is observed. Current projects aim to use the recent and spectacular invasion of D. suzukii to better understand the mechanisms of adaptation to a new environment, in particular the role of phenotypic plasticity. Finally, some projects have also been developed to consider new control methods against this formidable crop pest.

Ongoing projects

ANR SWING project: Genetics, plasticity and evolutionary potential of *Drosophila suzukii*

L'objectif général de ce projet que je porte et qui est réalisé en collaboration avec

The general objective of this project, which I lead and which is carried out in collaboration with
Vincent Debat (
ISyEB, MNHN),
Simon Fellous
et Arnaud Estoup (CBGP Montpellier) and Cristina Vieira (LBBE), is to study the evolutionary processes at play during a biological invasion with a focus on the mechanisms of adaptation. We are also interested in the evolutionary potential of the invasive species in order to predict its capacity to adapt in the short and medium term. Thus, the different components are 1) to quantify the phenotypic variation of native and invasive populations using quantitative genetic methods and the study of reaction norms; 2) to characterize, at the genomic and transcriptomic level, the genetic basis of adaptation during the invasion process by determining the relative importance of natural selection and genetic drift on the phenotypic differentiation between native and invasive populations; 3) to combine these phenotypic and molecular approaches in order to better understand which traits are associated with invasion success, and to analyze the role of transposable elements in adaptation; 4) to evaluate the agronomic consequences of the plasticity and rapid adaptation capacity of D. suzukii.

ANR CRASHPEST project : A cascade of destabilizations: combining Wolbachia and Allee effects to eradicate the insect pest *Drosophila suzukii*

This project led by Laurence Mouton (LBBE) in collaboration with Emmanuel Desouhant (LBBE) and
Xavier Fauvergue
(ISA, Sophia Antipolis) aims to develop a method of control of D. suzukii based on the manipulation of processes intrinsic to populations, the meeting and compatibility of sexual partners, combining mating disruption and inoculation of bacteria of the genus Wolbachia.

ANR DroThermal project : What makes Drosophila suzukii such an effective invader ? an integrative analyses of its thermal ecology

The objective of DroThermal, led by
Hervé Colinet
(ECOBIO, Rennes), is to integrate different levels of variation across different spatio-temporal scales in order to better understand the thermal responses of Drosophila suzukii and thus to better predict the persistence and dynamics of populations at both local and global levels. This project will be carried out in collaboration with
Sylvain Pincebourde
(IRBI) for spatial variations,
Olivier Chabrerie
(EDYSAN) for trophic variations and Laurence Mouton (LBBE) for the integration of host-microbe interactions.

ANR LongevitY project : Exploring the contribution of sex chromosomes to male-female differences in aging and longevity

This project led by Cristina Vieira (LBBE) is a federative project at the laboratory level because it involves researchers from the four departments of the LBBE working on different aspects of aging and on various biological models (birds and large mammals, humans, Drosophila).

The main objective of the project is to test the contribution of sex chromosomes to the sex gap longevity (SGL). The underlying hypothesis is that in species with sex chromosomes, all deleterious recessive mutations are expressed on the single X chromosome in males and may reduce their lifespan, the so-called unprotected X effect. In addition, the many transposable elements (TEs) on the Y chromosome can affect aging. The activity of TEs is normally suppressed by epigenetic regulation (DNA methylation, histone modifications and small RNAs). However, it is known that this regulation is disrupted with age. Due to the Y chromosome, more ETs can become active in aged males than in aged females, generating more somatic mutations, accelerating aging and reducing lifespan in males, the so-called Y-toxic effect. My participation in this project will focus on characterizing the toxic effects of Y in different species and populations of Drosophila.

Responsabilités

Présidente du
CS INEE

Responsable du Pôle Biodiversité de la
FR BioEEnViS

Responsable du DIPEE Lyon St-Etienne