

Ecole Doctorale COMPLEXITE DU VIVANT – Fiche Projet CONCOURS

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Y-a-t-il un candidat déjà identifié pour le projet :

OUI

Responsable de l'équipe :

Teotónio, Henrique

Intitulé de l'équipe :

Génétique Evolutive Expérimentale

Nombre de statutaires de l'équipe titulaires d'une HDR :

1

Nom et prénom du responsable d'UMR ou de département :

Paoletti, Pierre

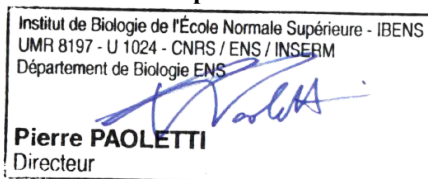
Intitulé et N° d'UMR ou de département :

Institut de Biologie de l'Ecole Normale Supérieure, ENS CNRS UMR8197 Inserm U1024

Titre du projet de thèse :

Evolution of recombination in finite populations

Signature du directeur d'UMR ou de département :



Spécialité :

Evolution, Génétique

Résumé du projet de thèse

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Variation in meiotic recombination rates within genomes and between individuals is common to all sexual species. Recombination affects the amount of genetic variation that might be available for natural selection, and is thus expected to impact adaptation to novel environments and the possibility of extinction under climate change. At present, however, experiments have not tested competing theoretical arguments regarding whether modifier alleles increasing recombination are favored during adaptation, particularly in finite populations with variable population structure. In this context, the PhD project has two main objectives: 1) to perform experimental evolution to measure selection on a recombination modifier under variable population sizes and population structure; and 2) to describe the fitness variance components that may explain selection on recombination. For this, the nematode *Caenorhabditis elegans* developed in the host lab for experimental evolution from standing genetic variation will be employed.

The student will perform two main evolution experiments on populations polymorphic for a modifier of recombination landscapes in *C. elegans* (*rec-1*), and domesticated to standard lab conditions. One experiment will require the manipulation of population census sizes, the other the levels of dispersal between subpopulations (demes), adapting to a novel environment. These experiments will be run for a maximum of 50 generations, and evolved replicate populations will be characterized for *rec-1* genotype frequencies, to estimate selection, and genome-wide SNP allele frequency changes, to describe genomic population genetics. During evolution, *rec-1* genotype fertility distributions will be further obtained to characterize adaptation to the novel environment. Finally, from evolved populations of the first experiment, recombinant inbred lines (RIL) will be obtained for alternative homozygous *rec-1* genotypes and line-cross analysis performed to estimate the genetic components (dominance, epistasis) of fitness distributions.

The thesis director, H. Teotónio, will be responsible for supervising the academic formation of the student, and for providing all the materials and equipment for the project success at the GEE team in IBENS. The “co-encadrant” is a tenured CR in the GEE team, whose primary responsibility will be to help the student design and analyze the genomics assays. The co-director, D. Roze, will help the student with the design of the evolution experiments and with the interpretation of the line-cross data, as it bears on theoretical models being developed in his team and that the project will in part test. Both during thesis committees and in biannual meetings between both teams the student will have the opportunity to discuss the project’s progress.

Faisabilité du projet de thèse

The host team is well known for establishing *C. elegans* to the study of evolution of self-fertilization and adaptation to variable environments, using an experimental evolution approach and methods from population and quantitative genetics. The co-director is a recognized leader in analytical and numerical theoretical evolutionary biology, focusing their questions about the evolution of sex and recombination. Both teams have collaborated for the past 5 years on the question of evolution of recombination under partial self-fertilization. For this they obtained an ANR grant (which will end in 2023) that partially funds one PhD student in each team. Both students are being co-supervised by H. Teotónio and D. Roze and they have already accomplished most of the objectives of their respective projects, being now in the third year and with plans to obtain a diploma in 2023.

The present current PhD project is a natural continuation of the collaboration between the two teams. The two teams have

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submitted an ANR proposal in 2021, a grant that will start in late 2022 in case it is funded, which includes theoretical and experimental studies of evolution of recombination in finite populations. In case the proposal is not funded, the director and co-director have other available funds to support the materials and equipment of the PhD project, including the most expensive ones such as genomic analysis. The director's team further has technical support from the host institution, in terms of kitchen and media preparation, and bioinformatics support (the last being also available at the co-director's host institution). The student will also work with short-term interns in the director's team (L3 and master's level). In the context of this PhD project, no further collaborations are envisaged at this time, though both teams regularly collaborate on specific research and technical problems with several other teams (M.A. Félix at IBENS, S. Proulx UC Santa Barbara, T. Lenormand at CEFE Montpellier, S. Glémin at EcoBio Rennes, etc.) that may be helpful to the student.

A current M2 student in the director's team already manifested great interest in the PhD project. This student is doing the "Magistère Européen de Génétique" of the Université de Paris, and already did the M1 internship in the director's team helping a PhD student on a project about the evolution of recombination under self-fertilization.

Thèses actuellement en cours dans l'équipe

Nom et Prénom du doctorant	Directeur(s) de thèse	Année de 1ère inscription	ED	Financement
Parée, Tom	H. Teotónio (D.Roze)	2019	ED515	ANR SelfRecomb
Stetsenko, Roman	D. Roze (H. Teotónio)	2019	ED227	ANR SelfRecomb

Trois publications récentes des directeurs de thèse :

Noble, L., M.V. Rockman and **H. Teotónio**. 2021. Gene-level quantitative trait mapping in *Caenorhabditis elegans*. G3, 11. doi: 10.1093/g3journal/jkaa061.

Roze, D. 2021. A simple expression for the strength of selection on recombination generated by interference among mutations. PNAS, 9: doi: 10.1073/pnas.2022805118.

Chelo, I.M., B. Afonso, S. Carvalho, I. Theologidis, C. Goy, A. Pino-Querido, S.R. Proulx and **H. Teotónio**. 2019. Partial selfing can reduce genetic loads while maintaining diversity. G3, 9. doi: 10.1534/g3.119.400239.

Docteurs encadrés par le directeur de thèse ayant soutenu entre la date de dépôt de ce dossier et il y a 5 ans :

Aucun