Ecole Doctorale - 104

Sciences de la Matière, du Rayonnement et de l'Environnement

EDSMRE

UNIVERSITY: LILLE, Faculty of Sciences and Technologies.

Scientific field : Biologie de l'environnement, des organismes, des populations**.**

Title of the thesis: Involvement of sex chromosomes in reproductive isolation in *Silene*

Supervisor: Pascal Touzet, Professor

Co-direction : /

Co-supervision :

Laboratoire(s) de Rattachement :

Laboratory: UMR 8198 Evolution, Ecologie et Paléontologie (Lille) ; UMR 8197 Institut de biologie de l'ENS (Paris).

Related research project: ANR SeCCSi

Obtained funding: ANR SeCCSi (100%)

ABSTRACT

Context

In species with separate sexes and sex chromosomes, sex chromosomes are believed to play a major role in reproductive isolation. This prominent role of sex chromosomes in reproductive isolation relies on the specific features of sex chromosomes compared to autosomes that favour the accumulation of genetic incompatibilities revealed in interspecies hybrids. This prominent role of sex chromosomes in speciation is reflected by the "two rules of speciation": Haldane's rule and the large-X effect.

Haldane's rule (HR) indicates that in crosses between species sharing the same pairs of sex chromosomes, the most affected sex in hybrids, i.e. the sex with the lowest fitness compared to the parental lineages, will be the one which is heterogametic, i.e. XY males or ZW females. The main explanation relies on the dominance hypothesis, where recessive or partially recessive genetic incompatibilities will accumulate on the X or Z chromosome, through positive selection or drift, and thus be revealed at the heterogametic stage (XY or ZW).

The large- X(Z) effect postulates a large effect of the X(Z) in reproductive isolation. This pattern is the finding that an excess density of genes causing hybrid sterility or inviability is generally detected on the sex chromosomes with fine-scale QTL mapping. This is also strongly supported by empirical and theoretical studies revealing less introgression on X/Z than on autosomes, i.e stronger and/or more barriers to reproduction. In addition, the turnover of sex chromosomes and thus the possible transition from XX/XY to ZZ/ZW systems or vice versa can result in a situation where two distinct sets of sex chromosomes meet in hybrids, where one chromosome appears to be dominant over the other one.

PhD project

While much research has been done on the role of sex chromosomes in animal speciation, particularly in relation to the Haldane's rule, there has been less focus on their role in plant speciation, mainly due to the rarity of dioecy in plants. Therefore, the PhD project aims to investigate this neglected effect of sex chromosomes on reproductive isolation and speciation in plants, specifically by taking advantage of the properties of *Silene* genus.

In *Silene*, there is a unique opportunity to study the effect of Haldane's rule for both types of sex determination systems (XX/XY and ZZ/ZW) on reproductive isolation. But *Silene* also allows us to understand the genetic interactions between these two systems when they meet in hybrids. To accomplish this, interspecies crosses have been generated in order to evaluate the fitness of both male and female hybrids. QTL mapping and transcriptomic analyses will be performed to identify genetic loci and pathways involved in reproductive isolation. In addition, using a population genomics approach, the evolutionary and demographic scenarii of speciation will be investigated and the level of introgression between sex chromosomes and autosomes will be compared. This will allow to quantify the effect of sex chromosomes as species barriers and to detect the possible occurrence of a large-X/Z effect.

Evo-Eco-Paléo

The candidate must hold an MSc degree and have a strong background in Evolutionary biology. The ideal candidate should be motivated, have good communication skills, and be willing to work independently as well as part of collaborative projects.

Planned recruitment date : 01/10/2024

Contact (e-mail address) : pascal.touzet@univ-lille.fr