Stage M2 : Towards a better understanding of population genetic's structure: contribution of species distribution models

Localisation : Écologie et Dynamique des Systèmes Anthropisés (EDYSAN), UMR7058 CNRS UPJV, AMIENS

Summary (up to 300 words):
The internship proposed follows Pedro Poli's thesis (2021) entitled « *Integrating genetic variation and species distribution models to better understand species' evolutionary history and improve redistribution projections under climate changes* ». In his work, Pedro investigated the integration of Species distribution models (SDMs) and population genetics and phylogeography to better inform SDMs and disentangle the abiotic selective pressures on gene flow under climate changes.

Background
The history and genetic structure of a population usually reflect the combined action of evolutionary forces such as mutation, natural selection, genetic drift and gene flow. One way of studying the impact of natural selection on the structure of populations and understanding their genetic adaptation to environmental change is to study their molecular evolution in both temporal and spatial dimensions. Such a molecular approach is particularly appropriate in the context of understanding species redistribution in response to past climate changes in Europe, since (i) past climatic oscillations are considered an important cause of population differentiation and (ii) the post-glacial expansion of many european taxa is known to have contributed to intraspecific genetic variation.

During Pedro Poli's PhD thesis, SDMs were applied to fit and predict the distribution of two forest-dwelling species, *Geum urbanum* and *Ixodes Ricinus*, under contemporary climate conditions and during the Last Glacial Maximum (LGM), respectively. Regressive and correlative methods were applied between allele frequencies and habitat suitability predictions to identify candidate loci under selection and test the hypothesis that shifts in the species' current genetic structure are a consequence of changes in habitat suitability since the LGM. The preliminary analyses show a significant variation in allele frequencies and loci potentially under selection linked to habitat suitability shifts.

Objectives
The recruited Master student (M2) will reanalyse part of the bioinformatics and biostatistical outputs previously obtained by Pedro Poli (2021) with the aim to draft a manuscript for a scientific article. One of the underlying question is « How historical and contemporary bioclimatic conditions do contribute to the genetic divergence and genetic structure of two European forest-dwelling species: the herb *Geum urbanum* and the tick *Ixodes ricinus?* ». In the absence of experimental data, answers are provided by a set of knowledge about the mechanisms by which genetic diversity evolves, and about the post-glacial history of vegetation and climate in Europe. The student will also carry out a systematic review of the literature on the topic.

Publications on the field of research (up to 3):
1. POLI P, LENOIR J, PLANTARD O, EHRMANN S, RØED K H, LEINAAS HP, PANNING M, **GUILLER A,** 2020. Strong genetic structure among populations of the tick *Ixodes ricinus* across its range. *Ticks Tick-Borne Dis.,* **11**: 101509. DOI: 10.1016/j.ttbdis.2020.101509
2. POLI P, GUILLER A, LENOIR J. 2022. **C**oupling fossil records and traditional metrics to test how genetic information improves species distribution models of the European *beech Fagus sylvatica*? *Eur. J. Forest. Res.*, **141**: 253-265. DOI: 10.1007/s10342-021-01437-1
3. PETERSON ML, DOAK DF, MORRIS WF, 2019. Incorporating local adaptation into forecasts of species' distribution and abundance under climate change. *Glob. Chang. Biol.*, **5**:775-793. DOI: 10.1111/gcb.14562.

Co-encadrants : Annie Guiller (Professor), Jonathan Lenoir (CNRS Researcher), Pedro Poli (Engineer, QA logiciel, Sogeti)

Durée du stage : 6 mois

Financement du stagiaire : indemnisation selon les dispositions légales en vigueurs

Contact : les candidats doivent envoyer un CV et une lettre de motivation à annie.guiller@u-picardie.fr et jonathan.lenoir@u-picardie.fr