PostDoctoral position (18 months) available at the Centre de Biologie pour la Gestion des Populations in Montpellier (France) and University of Wisconsin-Madison (USA).

Title: Development of statistical methods for the reconstruction of routes of biological invasion: inference of complex evolutionary scenario from genomic data using admixture graphs.

Admixture graphs (AG) describe the demographic history of a set of populations as a directed acyclic graph that represents population splits and merges. They are particularly useful in studying biological invasions, as they can model the recent introduction history of individuals from native and invasive population samples. AGs have great, as yet unexplored, potential for selecting a set of (most probable) invasion scenarios from large-scale population polymorphism data (obtained from the entire genome of the organisms under study). AGs can be inferred using statistical methods that employ simplified models of evolution based on allele frequency covariances between population samples. The selected graphs can then be exploited by more sophisticated methods, that use complex models and likelihood free inference techniques for model choice, parameter estimation, or goodness of fit. The inference of AGs is an active field of research, with recent methods based on maximum likelihood or Bayesian approaches. Because these methods need to explore the huge space of possible graphs, they are subject to a number of algorithmic and mathematical challenges. The aim of the post-doctoral project is to study the behaviour of these methods on simulated and real datasets (mainly full-genome polymorphism data for a large number of population samples from two invasive insect species), and, based on the results, to propose new improved statistical methods. Possible lines of research could include i) the integration of uncertainty in the estimation of the covariance of population allele frequencies and its adaptation to more complex data (e.g., Pool-Seq data); ii) the exploration of the AG space and the resolution of identifiability issues, using the related but distinct literature on phylogenetic networks; and iii) the improvement of model choice approaches to compare AGs (e.g. via likelihood-based scores).

Useful references:
Gautier et al. 2022 https://doi.org/10.1111/1755-0998.13557
Maier et al. 2023 https://elifesciences.org/articles/85492
Nielsen et al. 2023 https://doi.org/10.1371/journal.pgen.1010410
Rhodes et al. 2024+ https://arxiv.org/abs/2402.11693

- *Main PIs:* Arnaud Estoup and Mathieu Gautier (Biology and Population Genomics; INRAE Montpellier, France), Cécile Ané (Maths-Stat; University of Wisconsin-Madison, USA), Paul Bastide (Maths-Stat; CNRS, MAP5, University of Montpellier and soon at University of Paris Cité, France), Jean-Michel Marin (Maths-Stat; University of Montpellier, France)
- *Salary:* >2650€ per month (after taxes; cf. ca. >3100€ before taxes) depending on post-PhD experience.
- *Timing:* position available **from October 2024** with a starting date **between October 2024 and March 2025** (Phd degree obtained before taking up the position).
- *Note*: The Post-Doc will have the opportunity to spend a few months at the University of Wisconsin-Madison, USA (cf. co-supervision with Cécile Ané)

Application: A PhD in statistics / population genetics or relevant field is expected. Informal enquiries are highly encouraged. Please contact Arnaud Estoup (**arnaud.estoup@inrae.fr**). Formal application includes a letter of application with details on the motivation, a full CV, the names and contact details of two references, and the date of availability.

Application deadline: 15th of September 2024

Other information related to the position

The aim of the Centre de Biologie pour la Gestion des Populations is to understand the mechanisms that govern the evolution of populations of organisms that are important for agronomy, forestry, human health or the conservation of biodiversity.

Montpellier is a major hotspot for evolutionary and environmental research worldwide and has a vibrant research community with several hundred researchers in this domain, and highly praised graduate programs. The University of Montpellier is top ranked in the Shanghai ranking in Ecology. Montpellier lies near the Mediterranean region in the South of France and enjoys pleasant weather, fantastic nature and great cultural and city life.

For information on the cost of living in Montpellier, France, you can consult the following websites:

- Numbeo: This is probably the most comprehensive site for cost of living comparisons between cities. It offers details of the cost of food, housing, transport, etc., based on user contributions. (www.numbeo.com)
- Expatistan: Another useful site that provides an overview of the cost of living in different cities, including Montpellier. It is also based on user contributions. (www.expatistan.com)