

Post-doctoral offer – between 12 and 18 months

Molar morphology of murine rodents: describing the 3D occlusion pattern in order to understand functional significance of intra- and inter-specific variation in a phylogenetic context

Context. – Understanding the evolutionary dynamics that led to the modern biodiversity is a key issue, intermingling in a complex interplay constraints and functional drivers of the diversification. This interplay will ultimately determine evolutionary patterns along phylogenies, with some morphological characters following expectations of neutral evolution while others, being under selection, will depart from it. Ecological and functional shifts are therefore likely to promote accelerated morphological evolution (Renaud et al., 2007), and some traits, associated with episodes of diversifications, are interpreted as key innovations. Their functional relevance is however too often a post-hoc interpretation, especially regarding fossil taxa.

Rodents constitute the most diversified mammalian order. They include the murine rodents (Old World rats and mice), including nowadays ~120 genera and 550 species. They display a large ecological dietary diversity, ranging from herbivorous to carnivorous taxa (Fabre et al., 2017; Michaux et al., 2007). Molars, being highly mineralized, are the most abundant fossil remain for these usually small-sized animals, and they are known to retrieve both a phylogenetic (López-Antoñanzas et al., 2024) and adaptive signal (Gómez Cano et al., 2013; Renaud et al., 2005). The phylogenetic relevance of morphological characters allows reconstructing total evidence phylogenies including fossil taxa (López-Antoñanzas et al., 2022); however, this approach may overlook selective pressures acting on these traits, leading to potentially erroneous positioning of fossil species, especially if those experienced an ecological shift. An example is provided by *Malpaisomys*, a fossil taxa endemic from the Canary islands, that was considered as related to Arvicanthine rodents on the basis of its morphology (Boye et al., 1992; López-Martínez et al., 1998) before ancient DNA proved that it was in fact a mouse (Murini) (Pagès et al., 2012).

The characterization of the significance of morphological variation, from the intra-specific to inter-specific level, together with the modelling of character evolution along phylogenies, is a key for a better understanding of the evolutionary dynamics of molar evolution that led to the diversity of murine molars, and to a more robust assessment of the ecology and phylogenetic position of fossil taxa.

Objectives. – The post-doctoral project aims at assessing the functional relevance of variations in murine molar morphology, by mobilizing quantitative 3D methods and integrating several scales of evolution. The aims are to:

- Characterize the occlusal constraints on upper/lower molar morphology, based on few species such as the house mouse (*Mus musculus*) and the wood mouse (*Apodemus sylvaticus*);
- Extend this model to the within-species variation in these well-documented species (Ledevin et al., 2016; Renaud et al., 2018; Renaud and Michaux, 2007);
- Broaden the analysis to representatives of the main murine groups, in order to validate adaptive hypotheses regarding molar morphology along the phylogeny;
- Finally, reconsider at this light trait evolution, as reconstructed by molecular (Lecompte et al., 2008) and total evidence phylogenies (López-Antoñanzas et al., 2022), to question and enrich phylogenetic reconstructions for fossil taxa.

The surrounding environment

The project will be funded by the ANR RoMa « Rodent Macroevolution in the context of Major Miocene Environmental Changes », supervised by Raquel López-Antoñanzas (ISEM, Montpellier). Beyond recognized specialists of rodent paleontology (R. López-Antoñanzas, P. Peláez-Campomanes), RoMa associates world leaders in phylogenetic reconstructions (F. Condamine, ISEM, Montpellier; R. Aguilée, EDB, Toulouse). The postdoc will also benefit from interactions with the ANR project Disparat “Skull trait interactions and macroevolutionary dynamics of the adaptive radiation of rodents”, supervised by Lionel Hautier (ISEM, Montpellier), providing a preexisting 3D database regarding the morphological diversity of rodent dentition, and a potential for exchanges regarding functional morphology of the craniofacial complex, including dentition.

The post-doc will be located at the LBBE in Lyon, under the supervision of Sabrina Renaud (CNRS research director). She is specialist of murine evolution and geometric morphometrics, questioning the adaptive role of morphological variation (Renaud et al., 2007; Renaud et al., 2024; Renaud et al., 2018; Renaud et al., 2005), its developmental basis (Hayden et al., 2020; Renaud et al., 2009) and its role as constraints to evolution (Renaud et al., 2006). The LBBE’s RoMa team is completed by Pascale Chevret (CNRS researcher), well-known specialist in rodent phylogeny and phylogeography (Chevret et al., 2021; Chevret et al., 2020; Chevret et al., 2005). The team “Ecology and Evolution of Populations” further includes specialists in population genetics. The LBBE offers a rich background regarding diverse fields in evolutionary biology, from ecology to cutting-edge genomics.

Expected skills. – Advanced expertise regarding 3D quantitative methods is expected, and a focus on occlusal functioning would be welcome. 3D analyses will be performed using AVISO (available at the LBBE) and other free tools such as MorphoDig. Analyses will be mostly performed under R, and expertise regarding packages of geometric morphometrics (e.g. geomorph) and/or phylogenetics will be considered as an added-value.

Informations for an application. – A CV, letter of motivation and addresses of reference scientists have to be sent to Sabrina Renaud (sabrina.renaud@univ-lyon1.fr) by July, 14th. The contract will be for a period of between 12 and 18 months, depending on the experience of the candidate. It is expected to start in autumn 2025.

References

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