



What is the ExposUM Doctoral Nexus?

The Doctoral Nexus proposed by the [ExposUM Institute](#) are networks of 3 to 4 PhD students from different disciplines and affiliated to at least two different research units.

Compared with a traditional PhD, taking part in a Doctoral Nexus will encourage the ability to work in a team and to design projects in a transdisciplinary way while deepening one's own field of expertise.

A specific teaching programme will be offered and the doctoral students concerned will also have the opportunity to organise a seminar within the Nexus network.

Theses are funded from the outset for 4 years, including the PhD student's salary and an environmental allowance

Thesis title

Characterizing the diversity and circulation dynamics of *Leptospira* in coypu populations using a combination of epidemiological and landscape genetics approaches

Thesis supervisors

- Nathalie CHARBONNEL, Senior Researcher (DR), INRAE, UMR CBGP
- Karine BERTHIER, Researcher (CR), INRAE, UMR CBGP and PV

PhD Project Summary

Context

Pathogens are typically distributed heterogeneously across space due to ecological and evolutionary processes. In this context, landscape genetics approaches allow for the analysis of environmental factors affecting the spatial structure, density, and connectivity of host populations—characteristics with direct implications for the dispersal and persistence of infectious agents. These approaches can help identify environmental barriers or corridors influencing pathogen transmission.

Combining epidemiology and landscape genetics therefore enhances our ability to predict and manage zoonotic threats arising from interactions between wildlife and pathogens.

This thesis will apply such methods to coypu (*Myocastor coypus*) populations to characterize their spatial dynamics and those of *Leptospira* bacteria.



Objective

This project aims to understand the relationships between environmental heterogeneity, coypu ecology (social structure, population dynamics), and the zoonotic risk linked to the presence and circulation of *Leptospira*.

In the first phase, the goal is to describe the prevalence and the spatio-temporal distribution of *Leptospira* in coypu populations and in environmental samples (water and soil) from the Lez and Or river basins over two years. Comparing patterns observed in coypu and in the environment will help test their potential role as sentinel species for the surveillance of pathogenic *Leptospira*.

In the second phase, the aim is to characterize the genetic diversity of *Leptospira* strains circulating in coypu and compare it to those found in other animals, such as dogs, and in humans. This will help identify the emergence of new genotypes, provide better understanding of the epidemiology of animal leptospirosis, and assess potential contamination sources for humans.

Finally, the project will analyze interactions between the spatial genetic structure of coypu populations and environmental characteristics of the Lez and Or basins. This will offer insights into population functioning and allow inference of key parameters influencing the transmission of pathogenic *Leptospira*, particularly focusing on social organization and connectivity within and between basins.

Methodology

- Sampling campaigns will be conducted in collaboration with stakeholders involved in coypu population control.
- Detection of pathogenic *Leptospira* in coypu kidneys and environmental samples will be performed using qPCR. Identified strains will be characterized via molecular typing.
- Population genetic analyses will be based on microsatellite marker data. Various genetic indices will be calculated to estimate genetic connectivity and social structure in coypu populations.

Expected Results

This will be the first population and landscape genetics study on coypu in Europe, and the first assessment of zoonotic risk linked to this introduced species in Montpellier and its metropolitan area. Identifying environmental factors influencing host-pathogen dynamics will lay the groundwork for transdisciplinary reflection on prevention and communication strategies regarding zoonotic risks associated with coypu.

References

Michel V, Ruvoen-Clouet N, Menard A, Sonrier C, Fillonneau C, Rakotovao F, et al. Role of the coypu (*Myocastor coypus*) in the epidemiology of leptospirosis in domestic animals and humans in France. Eur J Epidemiol 2001;17:111–21. <https://doi.org/10.1023/a:1017931607318>.



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Vein J, Leblond A, Belli P, Kodjo A, Berny PJ. The role of the coypu (*Myocastor coypus*), an invasive aquatic rodent species, in the epidemiological cycle of leptospirosis: a study in two wetlands in the East of France. *Eur J Wildl Res* 2014;60:125–33. <https://doi.org/10.1007/s10344-013-0758-z>.

Garcia-Lopez M, Lorient C, Soares A, Trombert-Paolantoni S, Harran E, Ayrat F, et al. Genetic diversity of *Leptospira* strains circulating in humans and dogs in France in 2019-2021. *Front Cell Infect Microbiol* 2023;13:1236866. <https://doi.org/10.3389/fcimb.2023.1236866>.

Archie EA, Luikart G, Ezenwa VO. Infecting epidemiology with genetics: a new frontier in disease ecology. *Trends Ecol Evol* 2009;24:21–30. <https://doi.org/10.1016/j.tree.2008.08.008>.

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Berthier K, Piry S, Cosson J-F, Giraudoux P, Foltête J-C, Defaut R, et al. Dispersal, landscape and travelling waves in cyclic vole populations. *Ecology Letters* 2014;17:53–64. <https://doi.org/10.1111/ele.12207>.

Candidate Profile

The candidate must hold a Master's degree (or equivalent) in fields related to ecology, evolution and/or epidemiology (e.g., population biology, population genetics, evolutionary biology, landscape ecology, health ecology, environmental epidemiology, etc.).

Experience or a strong interest in Fieldwork with wildlife, Molecular biology, Statistical analyses and Spatial data analysis are expected.

Required skills include interdisciplinary collaboration (ecology, health, genetics), scientific communication (written and oral), scientific rigor, and strong organizational skills.



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Application procedure

The application must include the following

- a CV
- a letter of motivation
- a copy of the degree required for registration
- any additional specific information requested by the doctoral school GAIA
<https://gaia.umontpellier.fr>

If you would like to apply for this position, please send an e-mail to

- Nathalie CHARBONNEL (nathalie.charbonnel@inrae.fr)
- Karine BERTHIER (karine.berthier@inrae.fr)

with a CC to

- exposum-aap@umontpellier.fr

to inform them of your interest.

Before Saturday 31 May, 2:00 PM CET



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The University of Montpellier

KEY FIGURES

51857
students



73
research facilities

15
technology platforms

657
National and
institutional diplomas

17
faculties, schools and
institutes

9
doctoral schools

TOP 200
in the Shanghai
ranking

5132 employees
including **2818** teachers, researchers and research assistants

7800
scientific publications
in 2022

RESEARCH CENTERS

From space exploration and robotics to ecological engineering and chronic diseases, UM researchers are inventing tomorrow's solutions for mankind and the environment. Dynamic research, conducted in close collaboration with research organizations and benefiting from high-level technological platforms to meet the needs of 21st century society.

The UM is committed to promoting its cutting-edge research by forging close links with local industry, particularly in the biomedical and new technologies sectors.

More Information: <https://www.umontpellier.fr/en/recherche/unites-de-recherche>

SCIENTIFIC APPEAL

Open to the world, the University of Montpellier contributes to the structuring of the European higher education area, and strengthens its international positioning and attractiveness, in close collaboration with its partners in the I-SITE Program of Excellence, through programs adapted to the major scientific challenges it faces.

More Information: <https://www.umontpellier.fr/en/international/attractivite-scientifique>



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