

# Appel à projets 2025 - Sorbonne Université & Institut Pasteur

- Projet de recherche doctoral / PhD research proposal

**Title:** Exploring the role of dogs and European hedgehogs and their environment in human leptospirosis eco-epidemiology in Île-de-France, France.

## Context of the study

Leptospirosis is a potentially fatal zoonotic bacterial disease. In continental France, there are between 600 and 700 cases per year, but these numbers have been increasing since leptospirosis became a mandatory notifiable disease in August 2023. Leptospirosis is caused by pathogenic leptospires that require an animal host to multiply. Human contamination is often indirect, occurring through contact with an environment contaminated by the urine of an infected host [1].

While the most documented animal reservoir of leptospirosis worldwide is the rat, a study conducted in continental France between 2012 and 2015 showed an average renal prevalence of 37.5% in hedgehogs, higher than the prevalences recorded in carnivores, lagomorphs, rodents, and ungulates [2]. A follow-up study, targeting hedgehogs specifically in the region around Nantes, showed contamination with three different *Leptospira* species [3]. Interestingly, *Leptospira* infection did not affect the hedgehogs' renal function, suggesting that they may act as long-term shedders of *Leptospira* [3]. These results demonstrated for the first time that the *European hedgehog* is a reservoir of interest. However, its role in the epidemiological cycle of human leptospirosis in France and the impact of its ecology on pathogen transmission remains unexplored. This is particularly important in urban and peri-urban habitats where hedgehogs are commonly present in our gardens, and thus live in close proximity to humans. It becomes important to know to what extent such species can constitute a "Trojan horse" for leptospires potentially transmissible to humans and pets, and the possible impact of urban green areas in terms of pathogen exchange and public health.

Meanwhile, a national study conducted in 2019-2021 characterized pathogenic *Leptospira* strains circulating in dogs, with some overlap between the Species-Groups (SG) *Leptospira* spp. found in dogs and in humans in France [4]. Further exploration and comparison of the circulating pathogenic *Leptospira* species in different animal host species, including dogs and hedgehogs, would allow a better understanding of the local epidemiological cycle of human leptospirosis, as demonstrated in other studies [5].

## Research objectives

The objective of the doctoral research project will be to assess the potential role of the *European hedgehog* and dogs in the maintenance and / or dissemination of leptospirosis to humans in Île-de-France. Because the hedgehog is a wild animal living at the interface between different habitats (urban / peri-urban) and potentially in contact with different animal species, the ecological context will be further explored for this species. The project will aim to identify the ecological factors explaining epidemiological patterns observed in hedgehogs, and more specifically (1) to evaluate the renal (in deceased animals) or blood (in recovered animals) carriage of pathogenic *Leptospira* in European hedgehogs; (2) to describe the *Leptospira* serogroups found in seropositive hedgehogs and/or the *Leptospira* strains circulating in host reservoirs (by Microscopic Agglutination Test, sequencing PCR products and / or culture isolation); (3) to assess the climatic and ecological factors related to urbanization (e.g., pollution, human density, urban green spaces) associated with the prevalence of pathogenic leptospires in hedgehogs; (4) to examine the role of hedgehogs as well as dogs as reservoirs for human leptospirosis in Île-de-France.

In a "One Health" approach, this research will explore the ecological dynamics of the European hedgehog in space and time in relation to its infection with pathogenic leptospires in urban and peri-urban environments, as well as the diversity of this pathogen in hedgehogs compared to the diversity observed in human clinical cases and dogs in the same region. An ecological, serological, and molecular survey will be conducted on a population of injured hedgehogs in the Île-de-France region,

brought to the CHUV-Faune Sauvage (wildlife care center) at the Alfort Veterinary School. In order to better evaluate the strain diversity in hedgehogs, culture and isolation of *Leptospira* will be attempted from the kidneys of deceased animals, and successful isolates will be fully sequenced. Human and dog leptospirosis case data in Île-de-France will be obtained from the Institut Pasteur in Paris, the National Reference Center for leptospirosis. DNA samples from *Leptospira* PCR-positive dogs will also be collected through an existing collaboration between Institut Pasteur in Paris and ANTECH Laboratories. All collected data (human, hedgehog, dog, environment) will be aggregated to identify sources of exposure and risk factors for infection through a correlative approach using a Geographical Information System (GIS). A One Health approach should clarify the transmission dynamics and identify risk factors of this re-emerging zoonosis using the Île-de-France region as a study area.

## References

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2. Ayral, F. et al. Hedgehogs and Mustelid Species: Major Carriers of Pathogenic *Leptospira*, a Survey in 28 Animal Species in France (2012-2015). *PLoS One* 11, e0162549 (2016).
3. Ayral, F. et al. Chronic Carriage of *Leptospira interrogans* Genotype Associated With the Australis Serogroup by Naturally-Infected Hedgehogs (*Erinaceus europaeus*) at a Wildlife Health Centre in Northwestern France. *Zoonoses Public Health*. (2025). doi: 10.1111/zph.13206. Online ahead of print.
4. Garcia-Lopez, M. et al. Genetic diversity of *Leptospira* strains circulating in humans and dogs in France in 2019-2021. *Front Cell Infect Microbiol* 13, 1236866 (2023).
5. Guernier, V. et al. Human Leptospirosis on Reunion Island, Indian Ocean: Are Rodents the (Only) Ones to Blame? *PLoS Negl Trop Dis*, 10(6):e0004733 (2016).

## Supervision team

Sorbonne University and Institut Pasteur conducted a first exploratory study in 2024 about *Leptospira* infection and seropositivity in hedgehogs, showing a potential link between hedgehogs and dogs that could be separate from the human epidemiological cycle of the disease. The same team will further explore this topic through the co-supervision of the PhD student involved in this project.

- Director: Dr Vanina Guernier – iEES-Paris (UMR SU – CNRS – INRAE – IRD – Upec – UPC).  
Researcher on the epidemiology and ecology of bacterial infectious diseases.  
50% supervision
- Co-director: Dr Mathieu Picardeau – Institut Pasteur de Paris.  
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