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Prevalence of *Borrelia burgdorferi* genospecies in *Ixodes ricinus* ticks: models for surveillance and prevention based on the French citizen science program CiTIQUE

Bah Madiou Thierno¹², Durand Jonas³, Cougoul Arnaud¹², Optiz Thomas⁴, Frey-Klett Pascale³, Arsevska Elena⁵, Dagostin Francesca⁶, Xavier Bailly¹ & Karine Chalvet Monfray¹²

Lyme borreliosis in europe

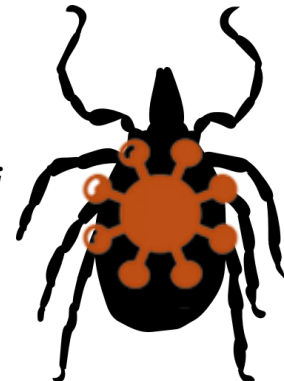
- 128,888 Lb cases per year in Europe

- Triggered by *Borrelia burgdorferi sensu lato*

- Most common human pathogenic Species =

- *Borrelia afzelii*
- *Borrelia garinii*

*Borrelia
Burgdorferi
Sensu lato
(Bbsl)*



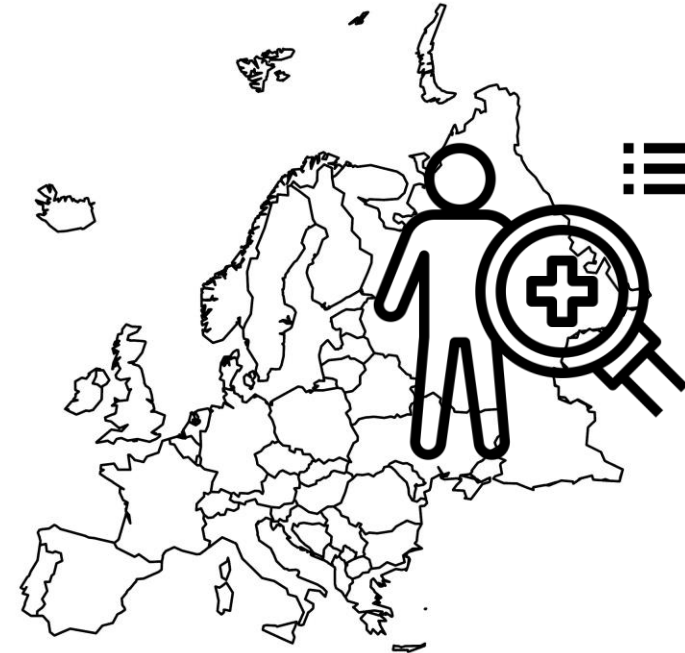
Ixodes ricinus



Borrelia afzelii



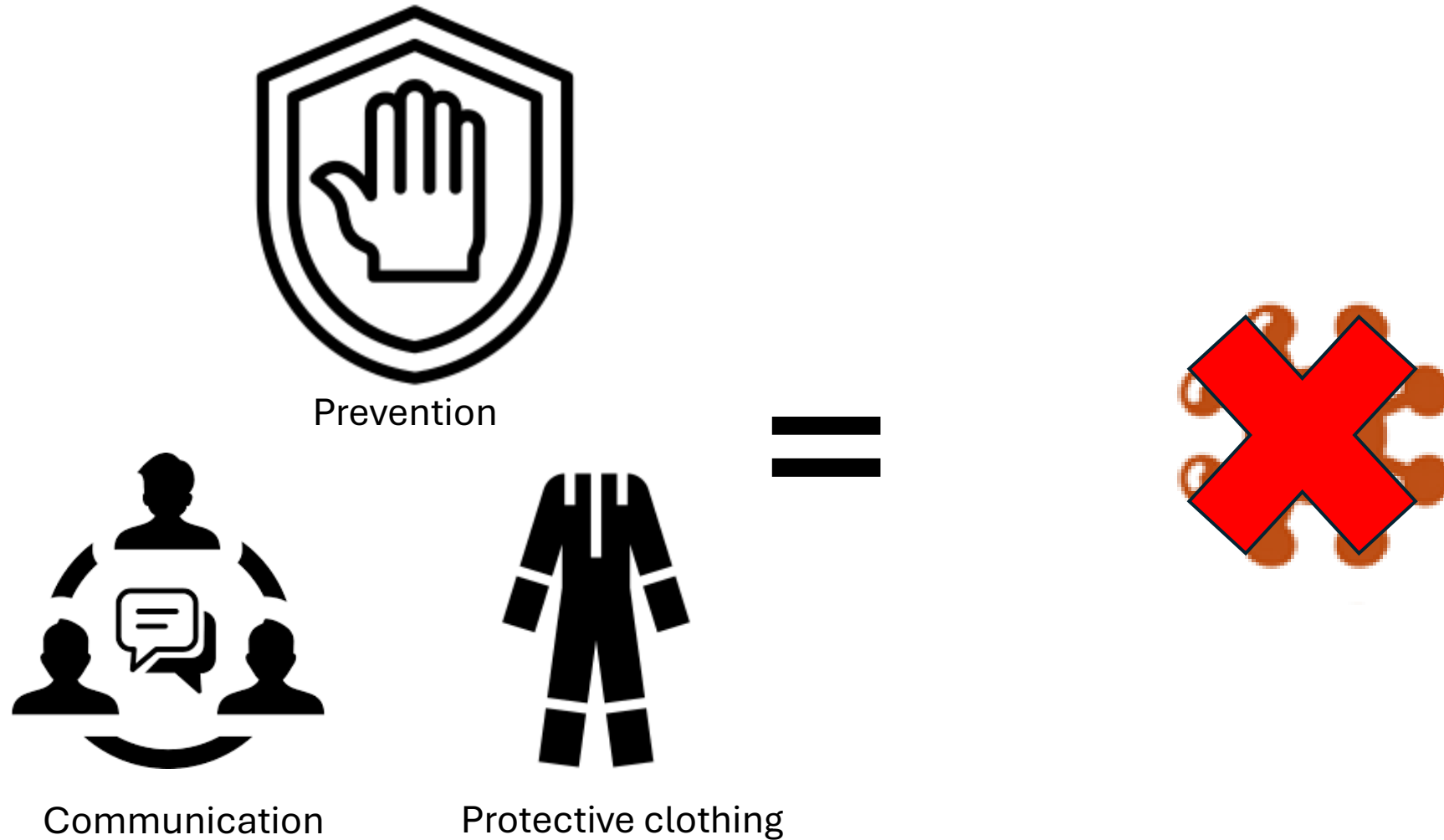
Borrelia garinii



128,888 cases per year

Lyme borreliosis (Lb) is the most prevalent factor in Europe

The best method to prevent cases



Lb prevention relies mainly on risk communication and the implementation of protective measures in high-risk areas.

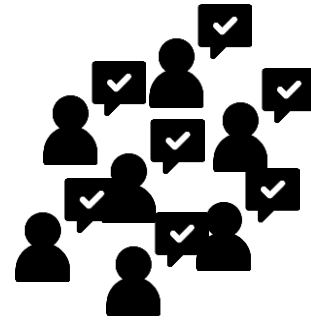
Various methods to monitor the spatial distribution of Bbsl



Host
sampling



Tick
sampling



Citizen
science



Case
reports

Accuracy



Scale

Many methods for monitoring Bbsl with their advantages and inconvenient

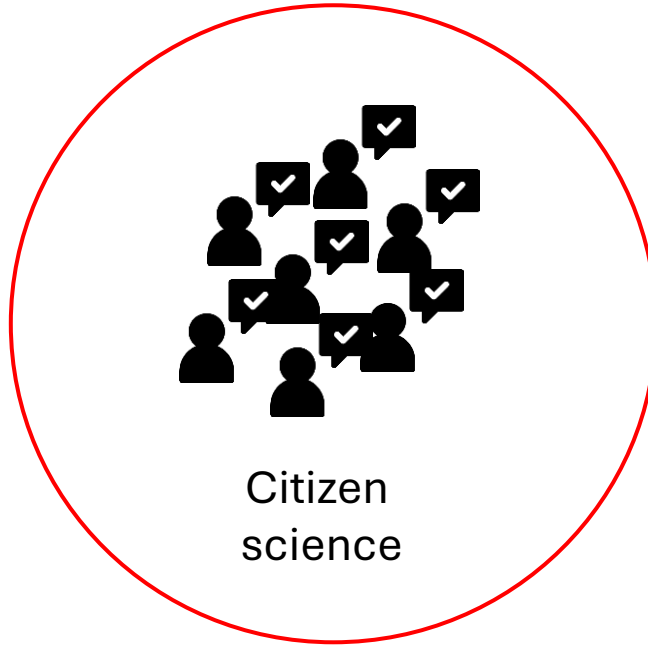
Various methods to monitor the spatial distribution of Bbsl



Host
sampling



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Case
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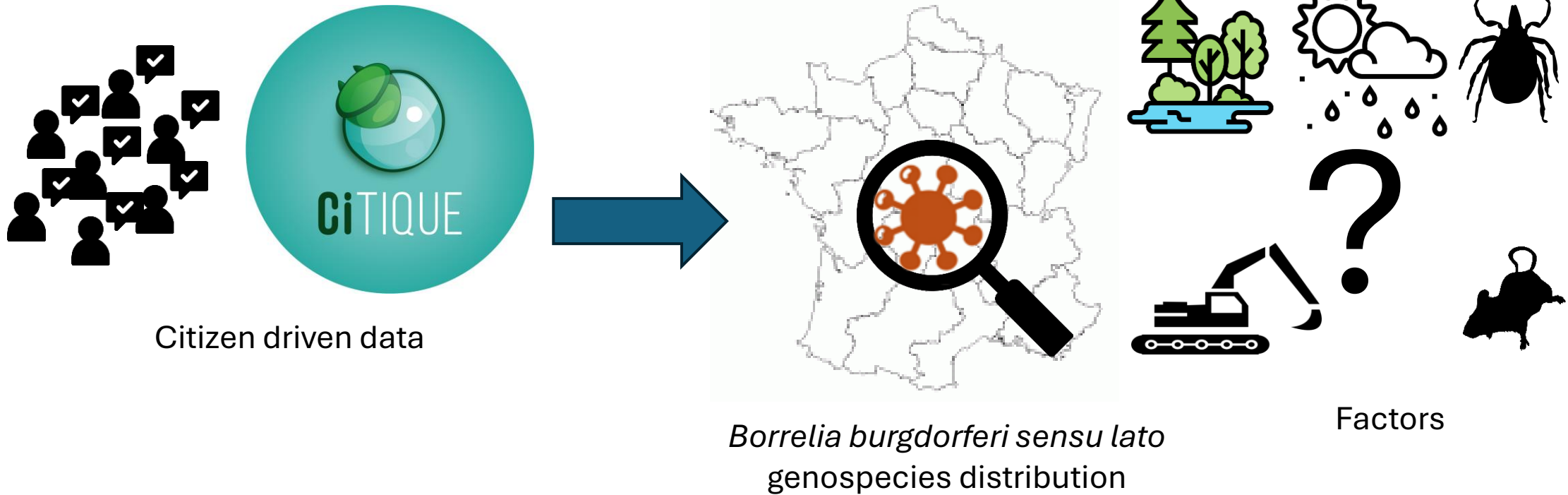
Accuracy



Scale

Many methods for monitoring Bbsl with their advantages and inconvenient

Study problematic



What are the factors associated with the distribution of Bbsl genospecies in Continental France ?

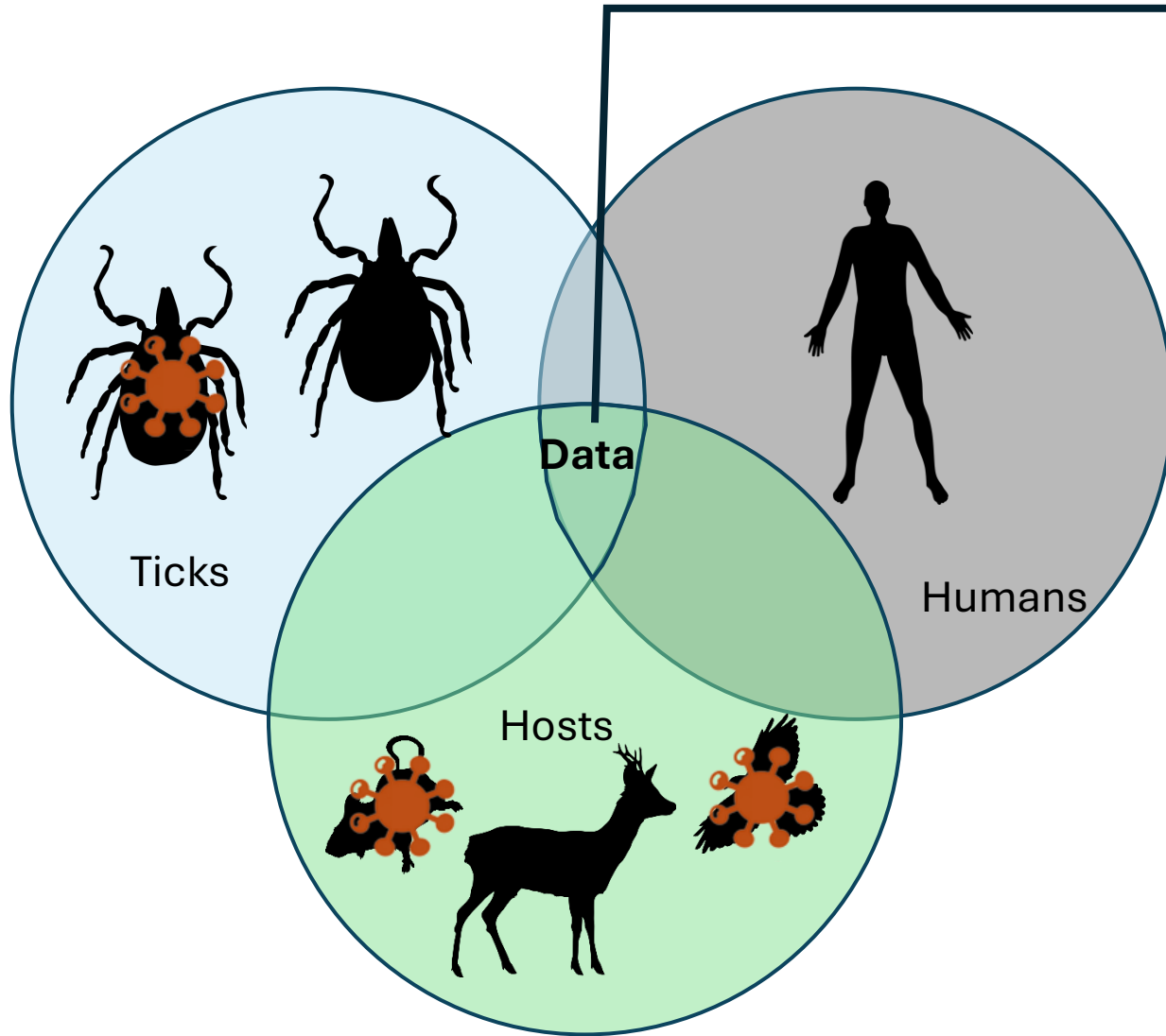
CiTIQUE in a nutshell



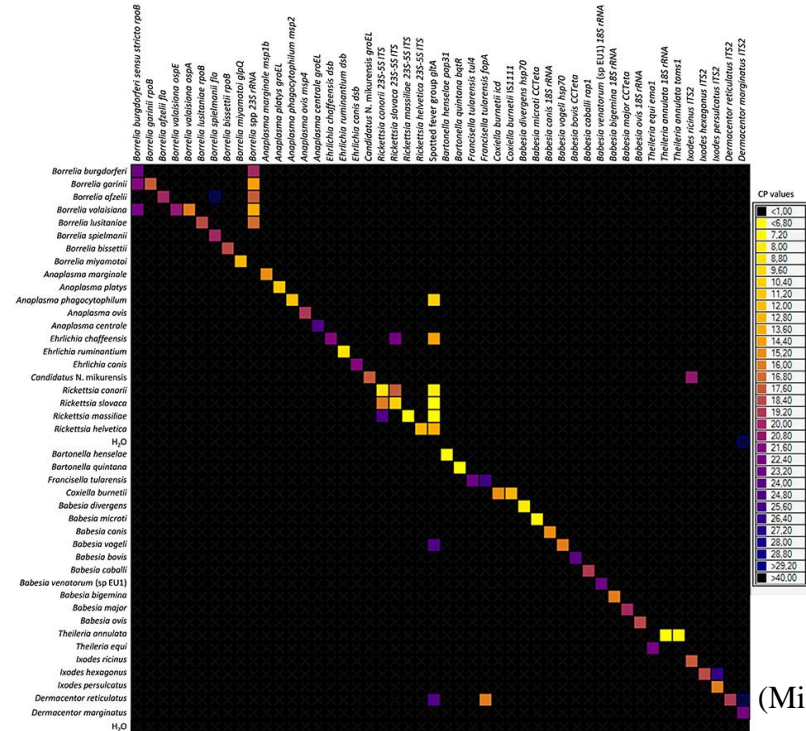
CiTIQUE objectives :

- Advance scientific knowledge on tick ecology and allow the development of new prevention methods
- Involving citizens in research to address a health issue
- Co-constructing research questions with various stakeholders (researchers, citizens, professionals)
- **Organize an unprecedented collection of information and biting ticks, unique in France and accessible to all researchers.**
- Create special opportunities for researchers and professionals to meet and debate
- Set up a collection of samples and associated data unique in France, accessible to all researchers: a tiquothèque

Data from CiTIQUE

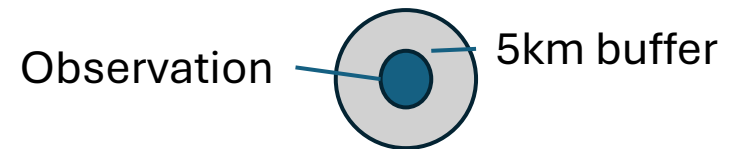


1887 biting *I. ricinus*



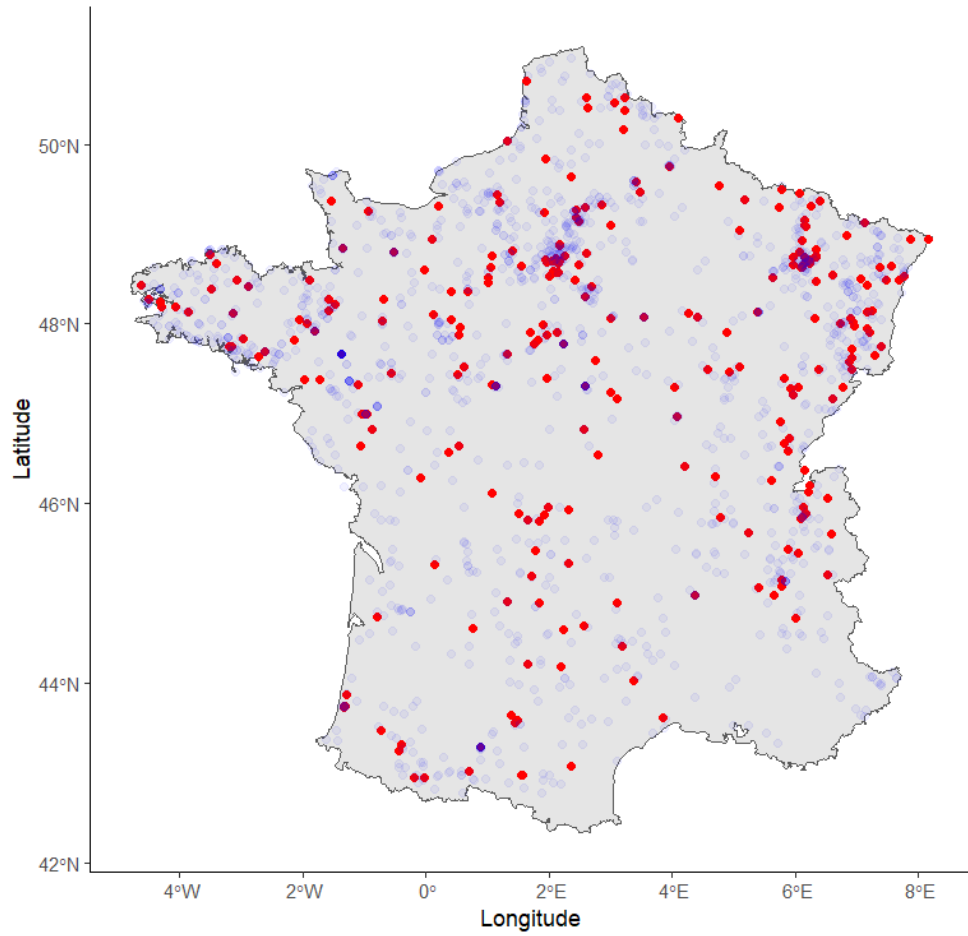
BioMark
dynamics
Systems

(Michelet *et al.*, 2014)



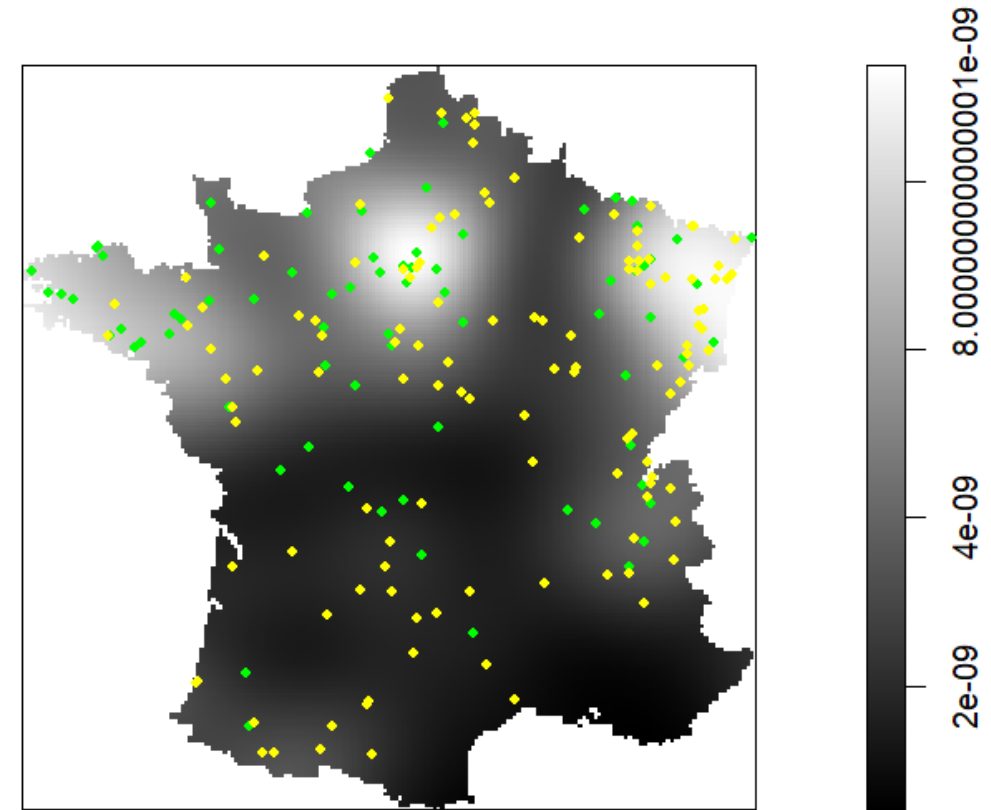
Covariates extraction

Observed Bbsl distribution in continental France

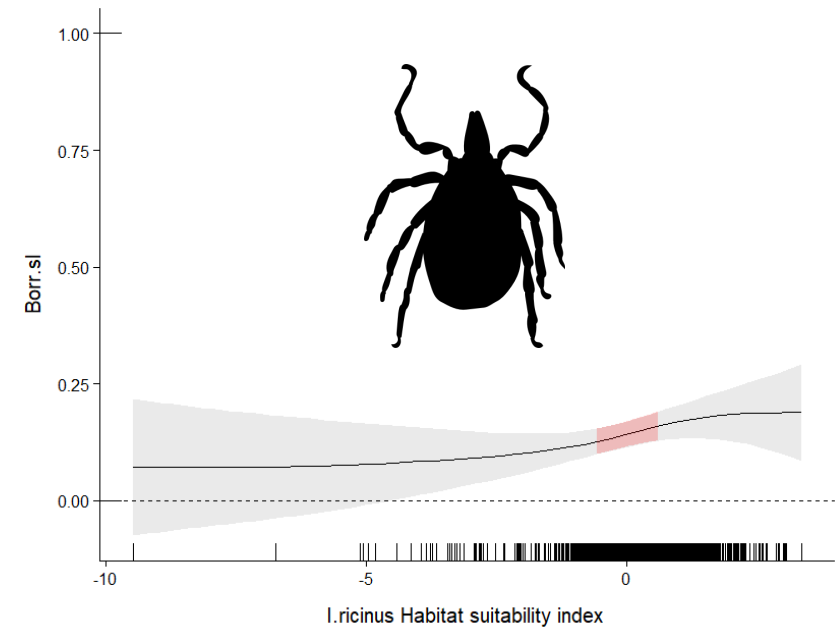
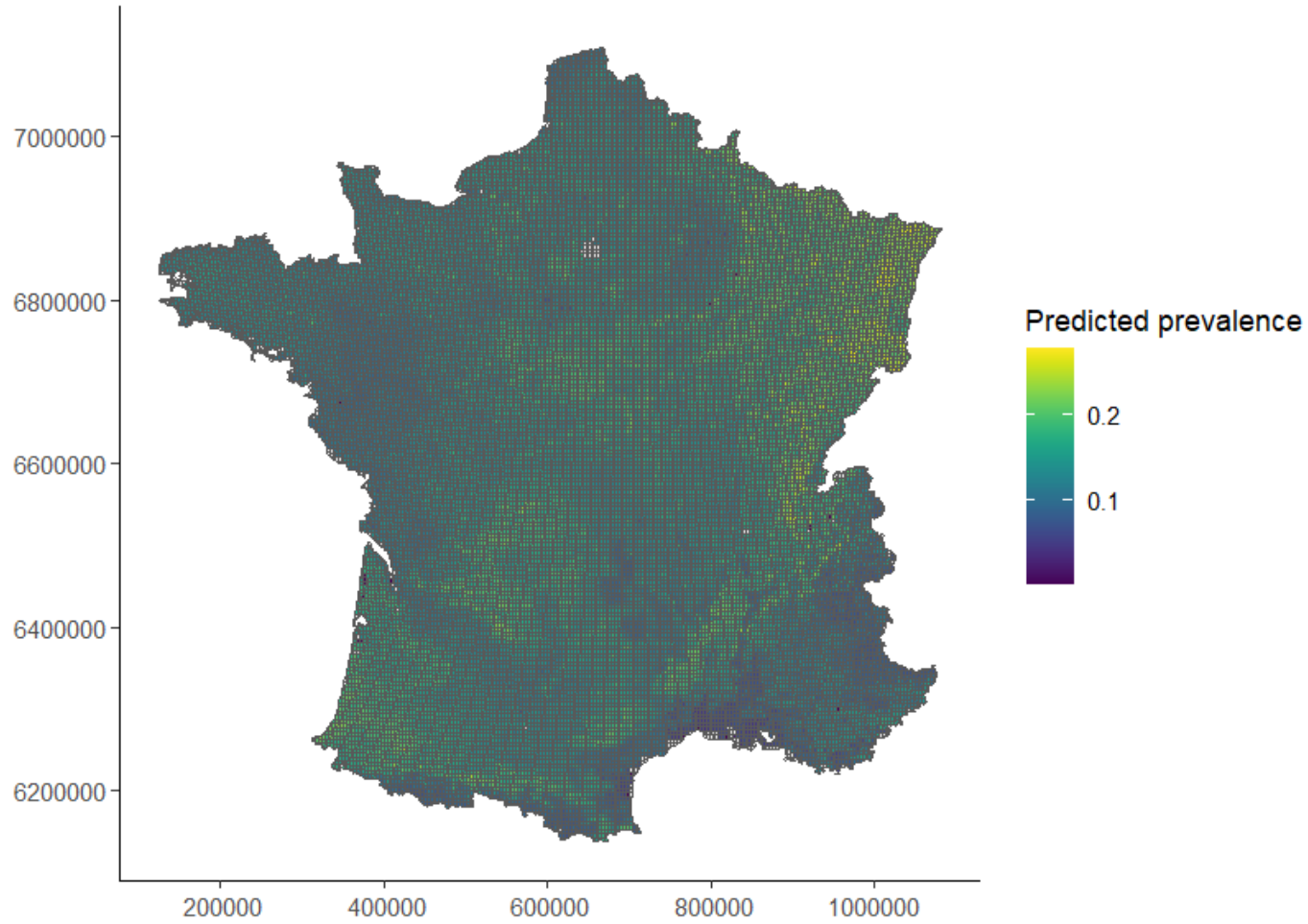


Borrelia afzelii ●

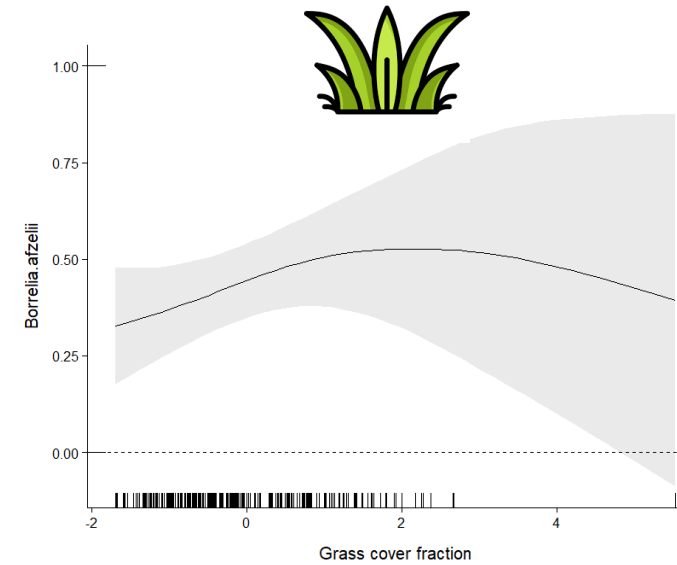
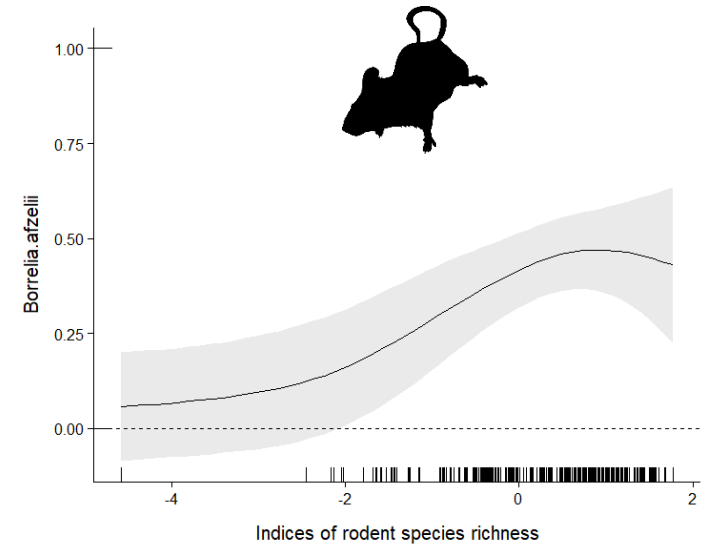
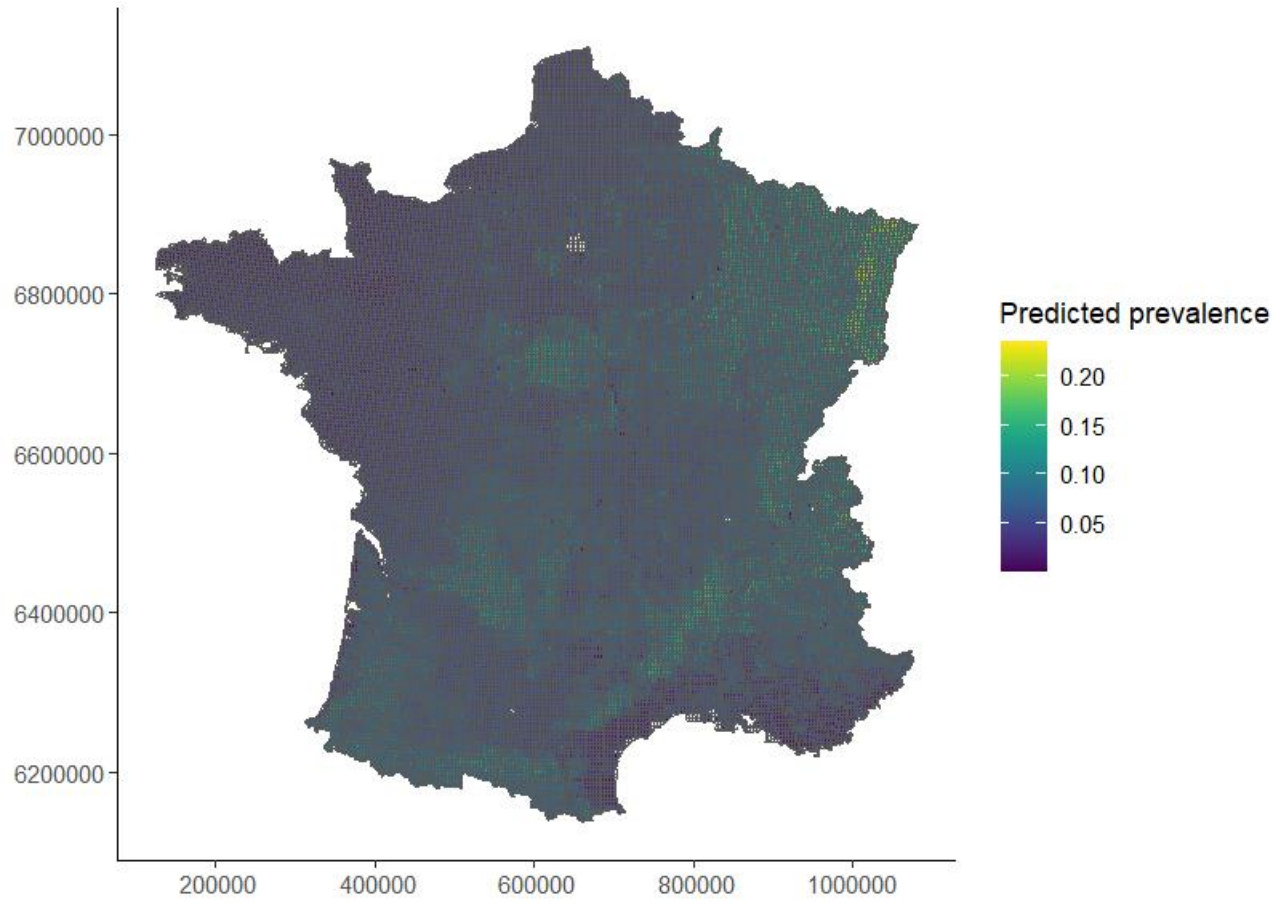
Borrelia garinii ●



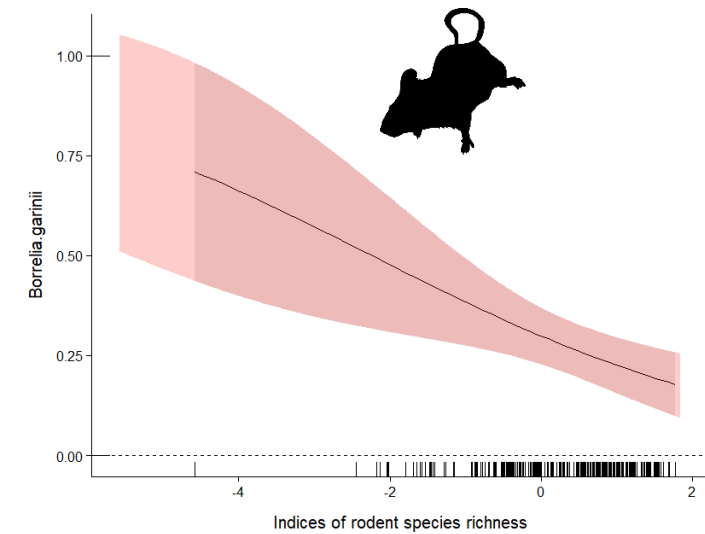
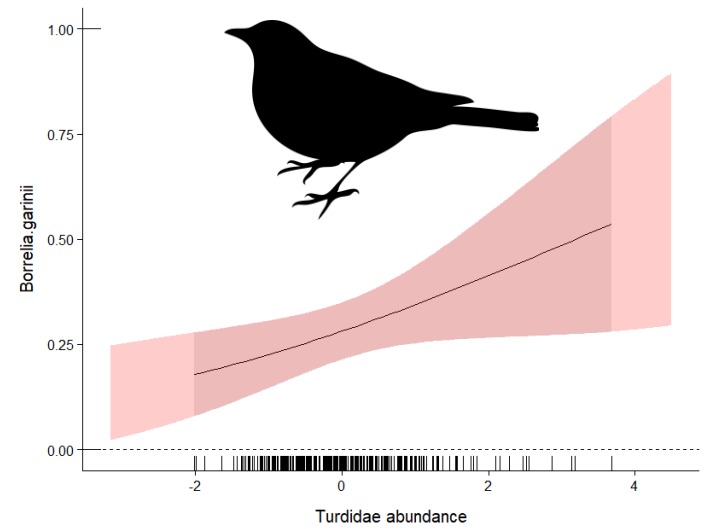
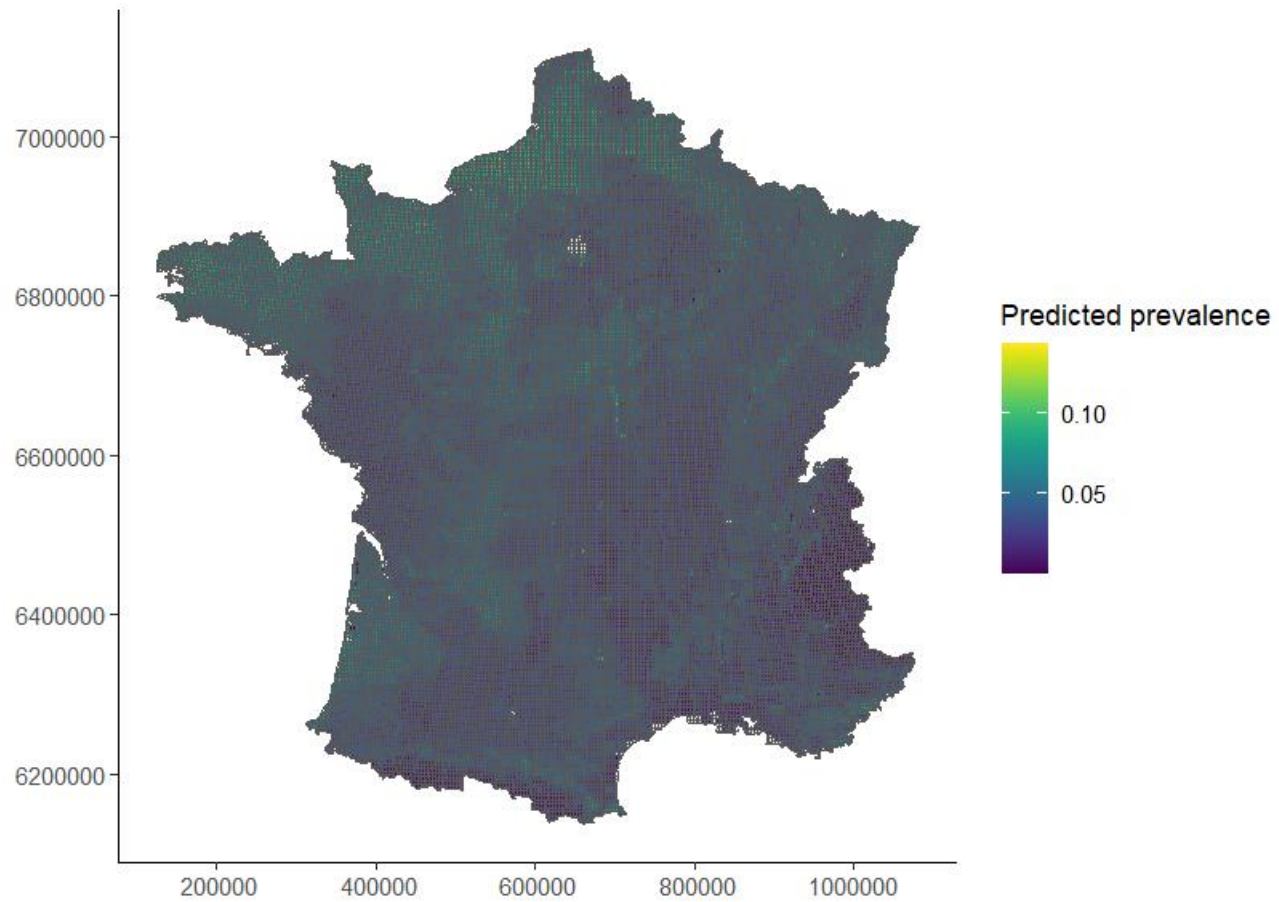
Factors influencing the prevalence for Bbsl



Factors influencing the prevalence for *B. afzelii*



Borrelia garinii predicted prevalence and relative risk



Models formulation

Formula

Borrelia ~ Selected covariables + constrained gaussian process on coordinates

Variable selection

Double penalty shrinkage methods

Two part modeling

Using all data

B. Burgdorferi sensu lato

Investigate factors associated with borrelia prevalence in the territory

Part 1

Using points where Bbsl was detected

B. garinii

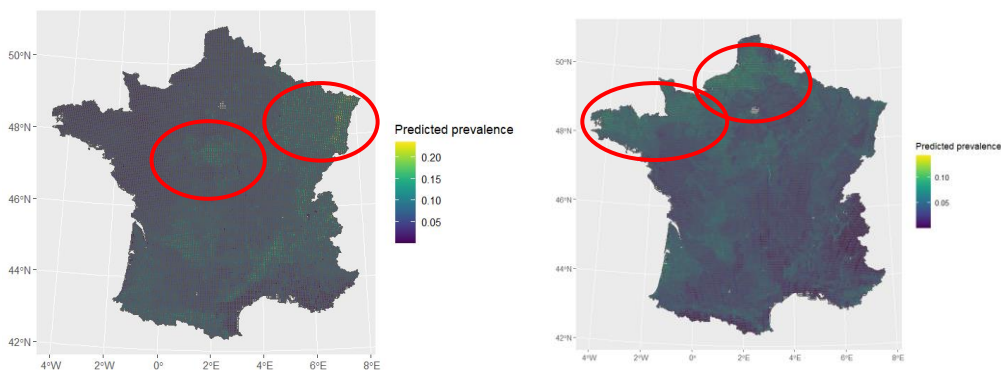
Identify factors associated with the presence of a particular genospecies.

B. afzelii

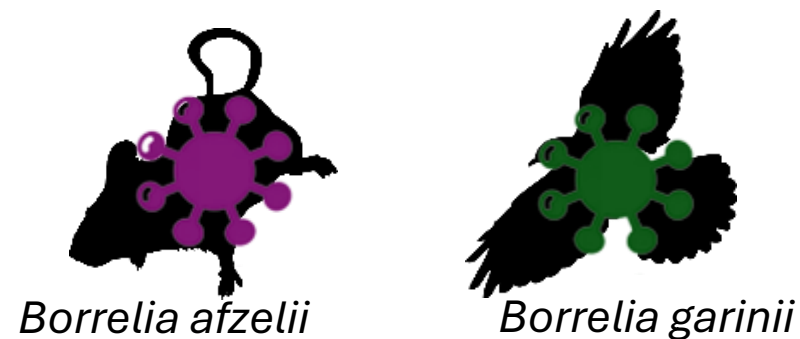
Part 2

Take home message

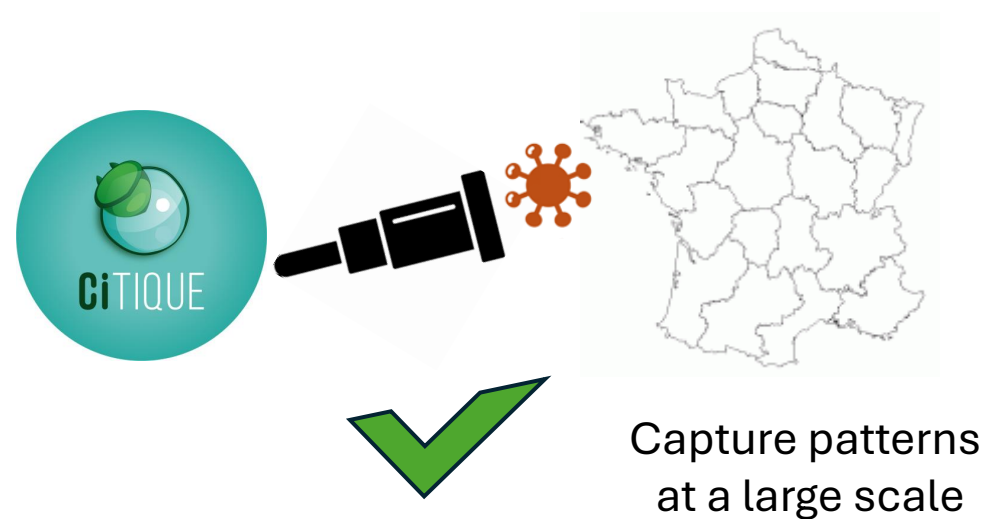
1 Heterogenous spatial distributions



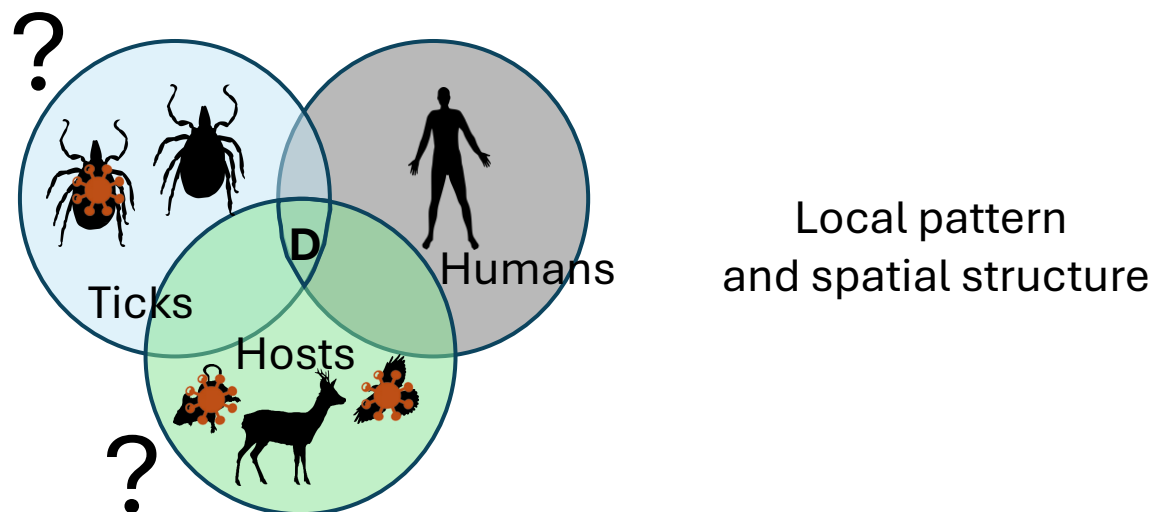
2 Due to hosts differences



3 CiTIQUE = good surveillance tool



4 With limitations and a lot of perspectives !



Thanks you for your attention !



<https://www.citique.fr/>

CiTIQUE - UMR EcoDiv IAM

Pascale Frey-Klett

Jonas Durand

UMR BIPAR - ANSES INRAE

Sara Moutailler

Clémence Galon



UMR EPIA INRAE-VetAgro Sup

Karine Chalvet-Monfray

Xavier Bailly

Arnaud Cougoul

UR MathNum BioSP

Thomas Opitz



H2020

- <https://mood-platform.avia-gis.com/>

William Wint - ERGO Oxford

Elena Arsevska - UMR ASTRE

Francesca d'Agostin - Fondation Edmund Mach



INRAE



VetAgro Sup

Contact: thierno-madiou.bah@inrae.fr