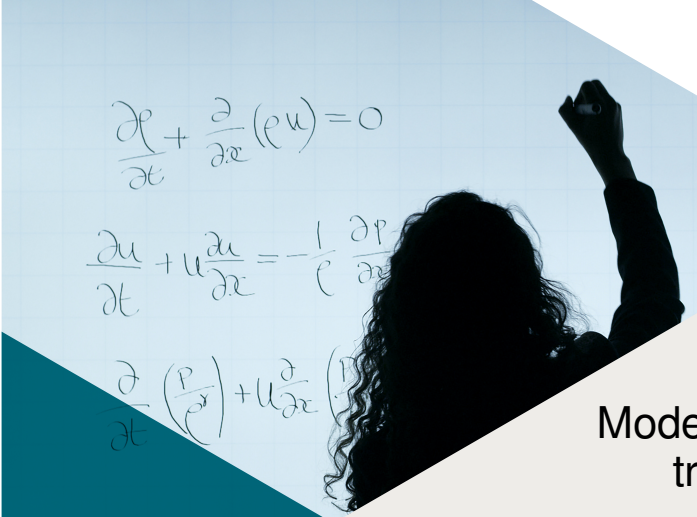
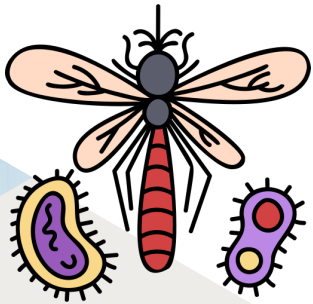


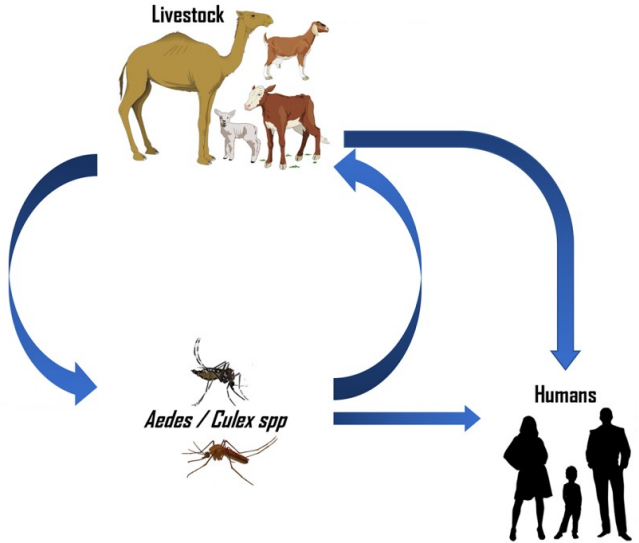


Modeling Rift Valley fever virus transmission dynamics

Insight from micro- to macro-scale studies

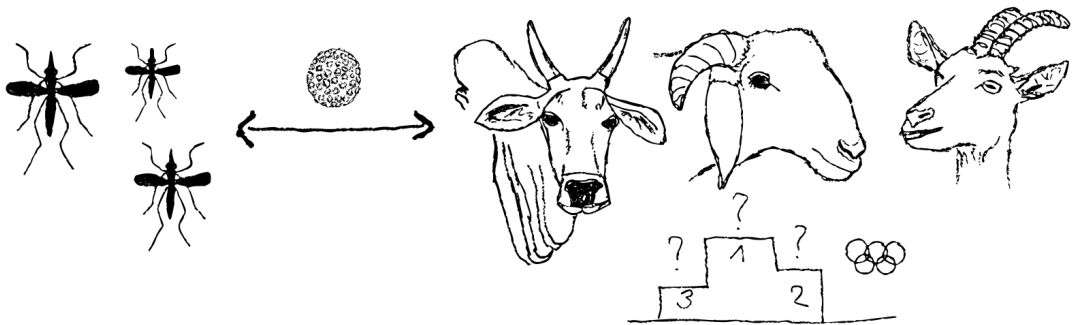
Hélène CECILIA

Rift Valley fever virus

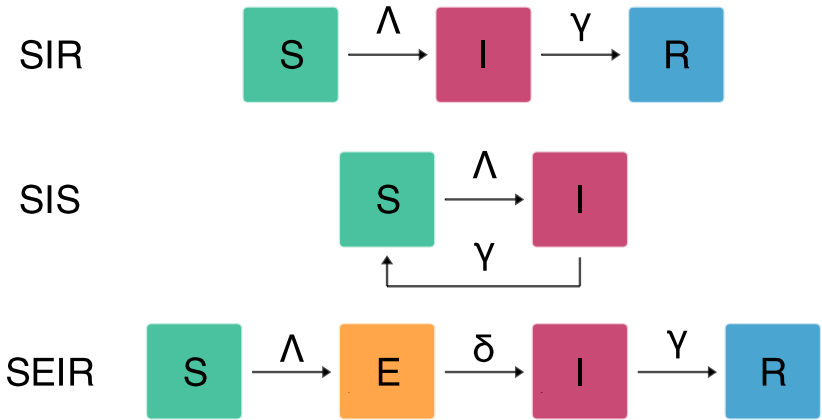


Research question

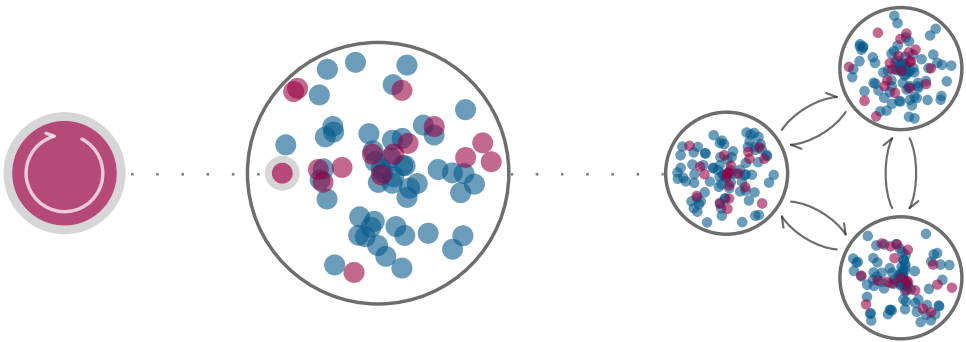
What is the relative contribution of livestock host species to RVFV transmission dynamics in Senegal?



Compartmental models



Scales



within-host

within-population

metapopulation

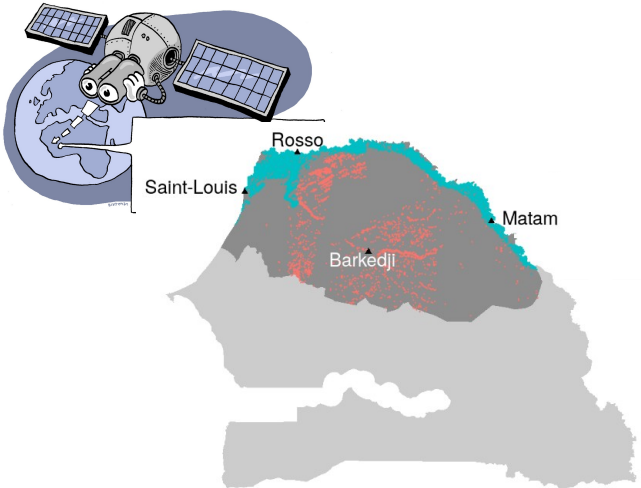
Epidemic potential in northern Senegal

Cecilia et al. 2020 *Epidemics*

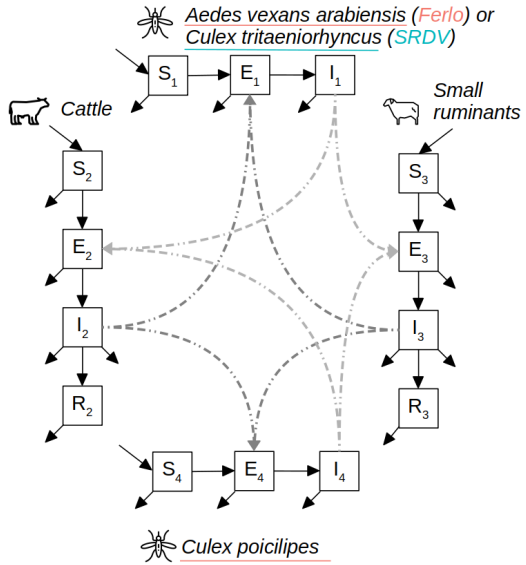
Objective

Explore RVFV suitability of two contrasted regions:

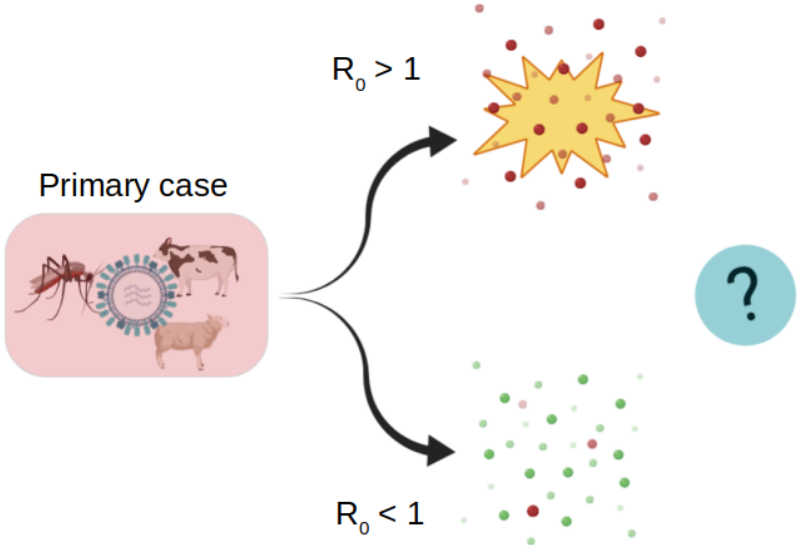
- Senegal river delta and valley (SRDV)
- Ferlo



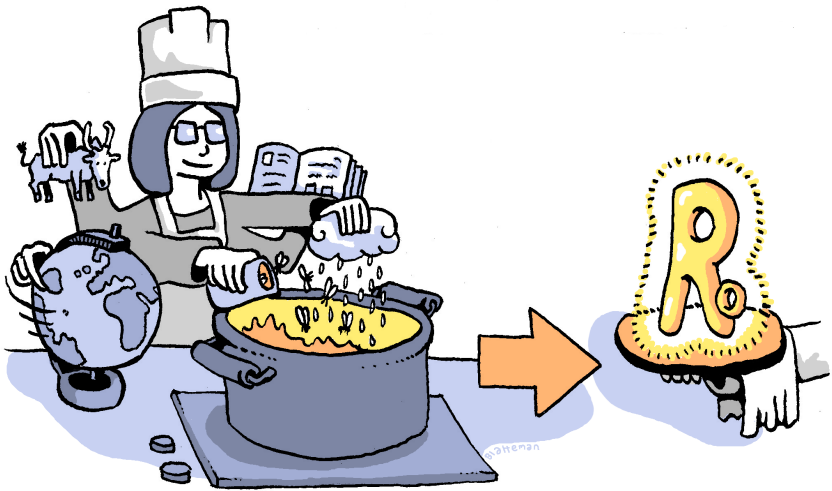
Model


Aedes vexans arabiensis (Ferlo) or
Culex tritaeniorhyncus (SRDV)
Cattle
Small ruminants
S1
E1
I1
S2
E2
I2
R2
S3
E3
I3
R3
S4
E4
I4
Culex poicilipes

Basic reproduction number R_0



Basic reproduction number R_0

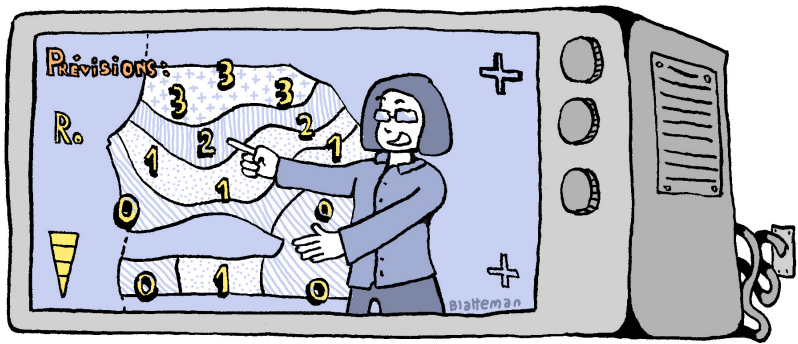


Results

September is the period of highest epidemic potential in northern Senegal

Immunity in cattle has a stronger effect on R_0 than in small ruminants

To be addressed : Hosts do not differ in their individual competence

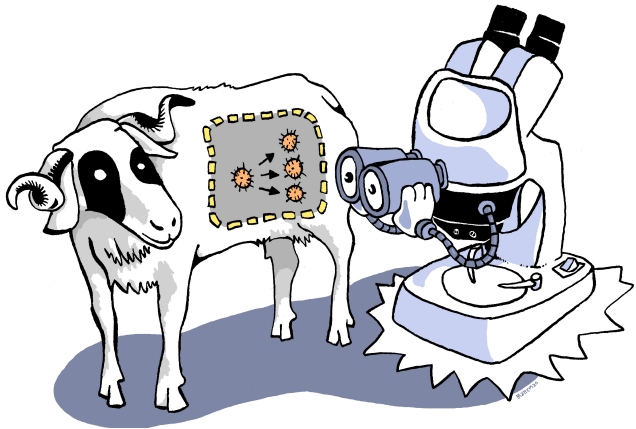


Transmission potential of livestock hosts

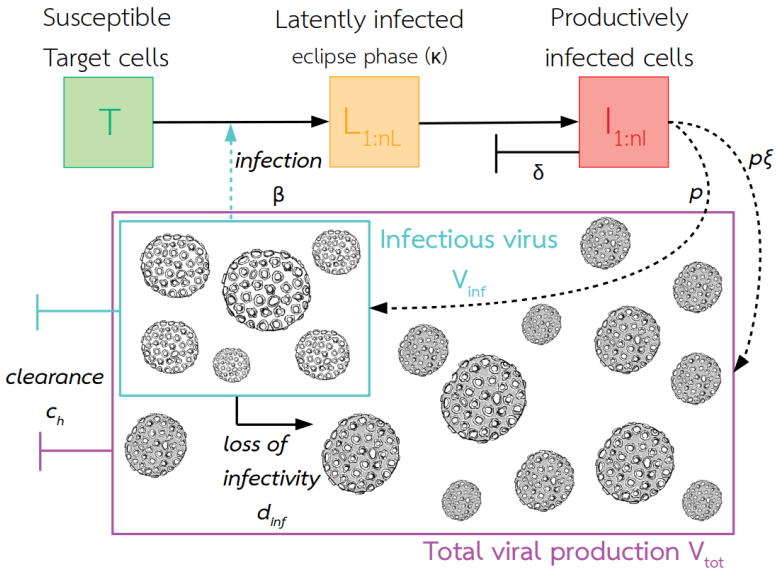
Cecilia et al. 2022 *Plos Computational Biology*

Objective

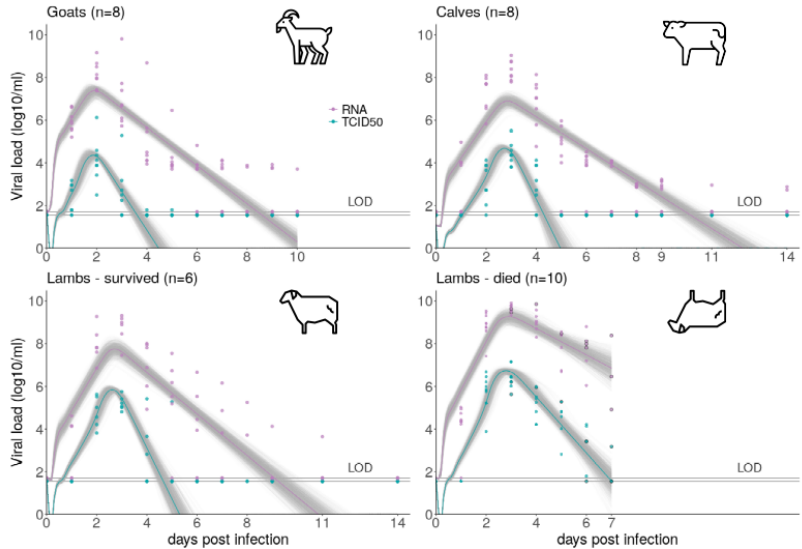
- Understand viral dynamics within RVFV livestock hosts
- Assess how efficiently livestock species can transmit RVFV to mosquitoes



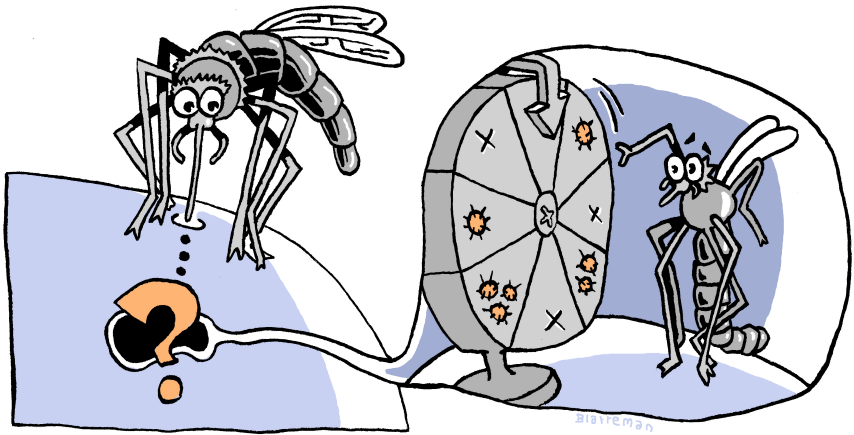
Within-host model



Model fit


Goats (n=8)
Calves (n=8)
Lambs - survived (n=6)
Lambs - died (n=10)
Viral load (log10/ml)
RNA
TCID50
LOD
days post infection

Probability to infect mosquitoes

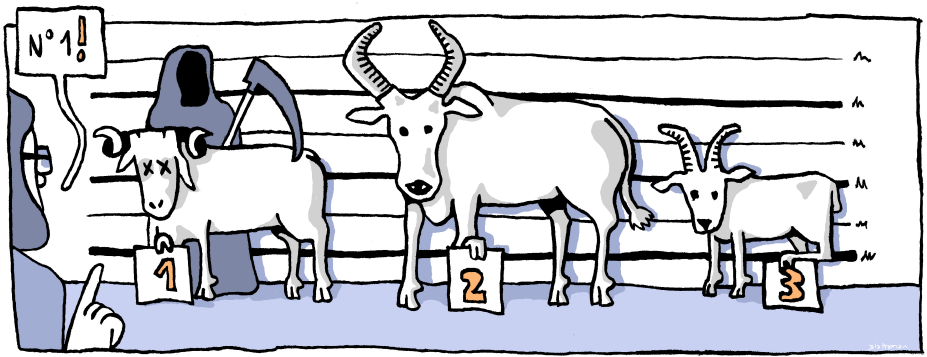


Results

Lambs are 3 to 4 times more infectious than cattle and goats

Lambs succumbing to RVF are more infectious than those less severely affected

To be addressed : How does this impact transmission at the population level?



Last chapter - Metapopulation model

Understand RVFV transmission dynamics at large scale,

taking into account *individual heterogeneity*,

in a context of **seasonal, pendular animal mobility**

Conclusion

- Mathematical modeling is an efficient way to combine different sources of knowledge, particularly relevant to understand the complex eco-epidemiology of vector-borne, multi-host diseases

- More data needed to confirm/infirm our conclusions and eventually lead to operational recommendations for RVF control in Senegal

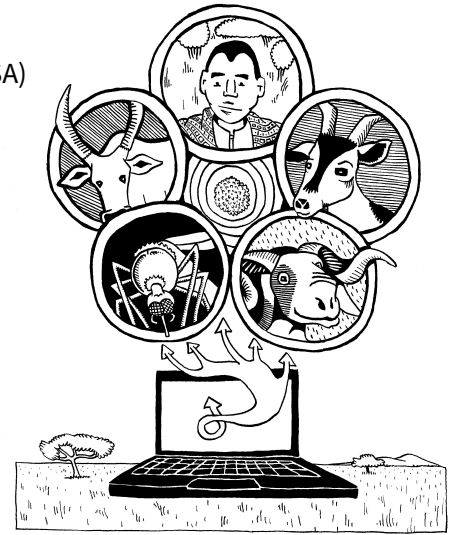
Questions?

My current job :

Postdoc

New Mexico State Univ. (USA)

Dengue and Zika virus in non-human primates



INRAE Oniris

cirad

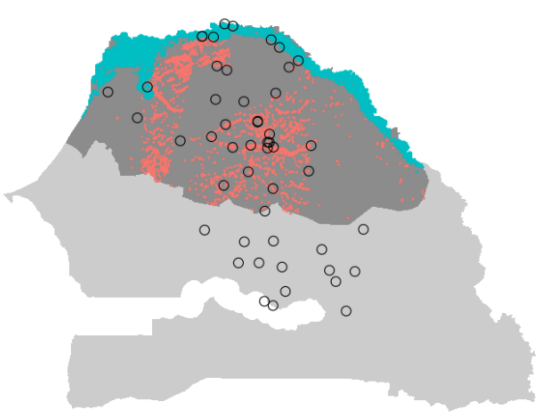
Région PAYS DE LA LOIRE

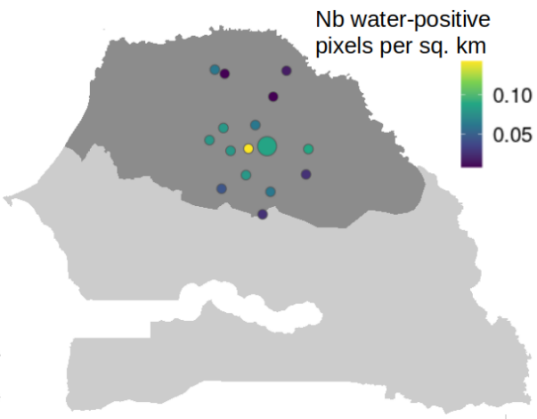
FORESEE project

Metapopulation

New data : field survey of 132 nomadic herders

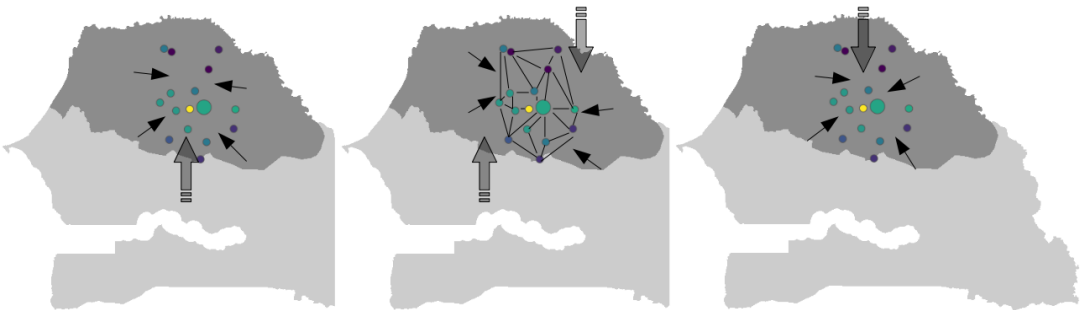
From 4378 pixels... to 16 patches



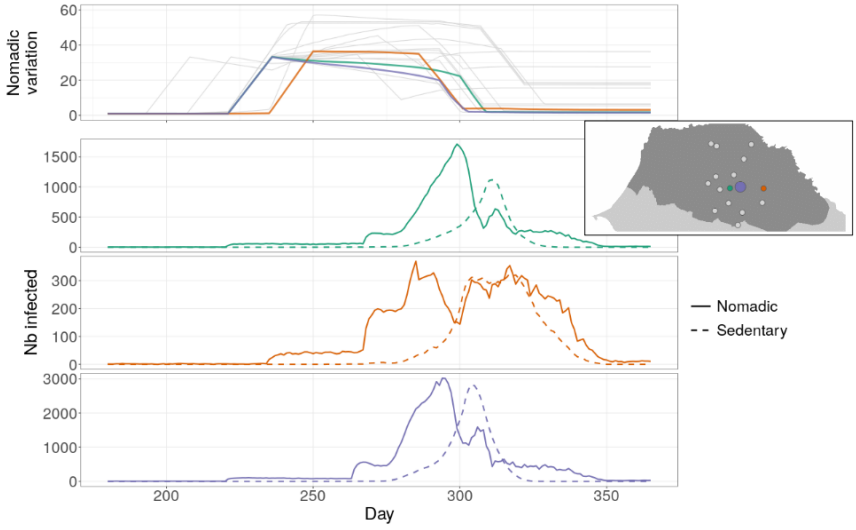


Metapopulation

Synthetic, seasonal movements during the rainy season



From nomadic to sedentary



Contribution of species