Direct estimation of the dynamic of contact between poultry and wild ducks in African villages using distribution modeling based on satellite telemetry and remote sensing data.

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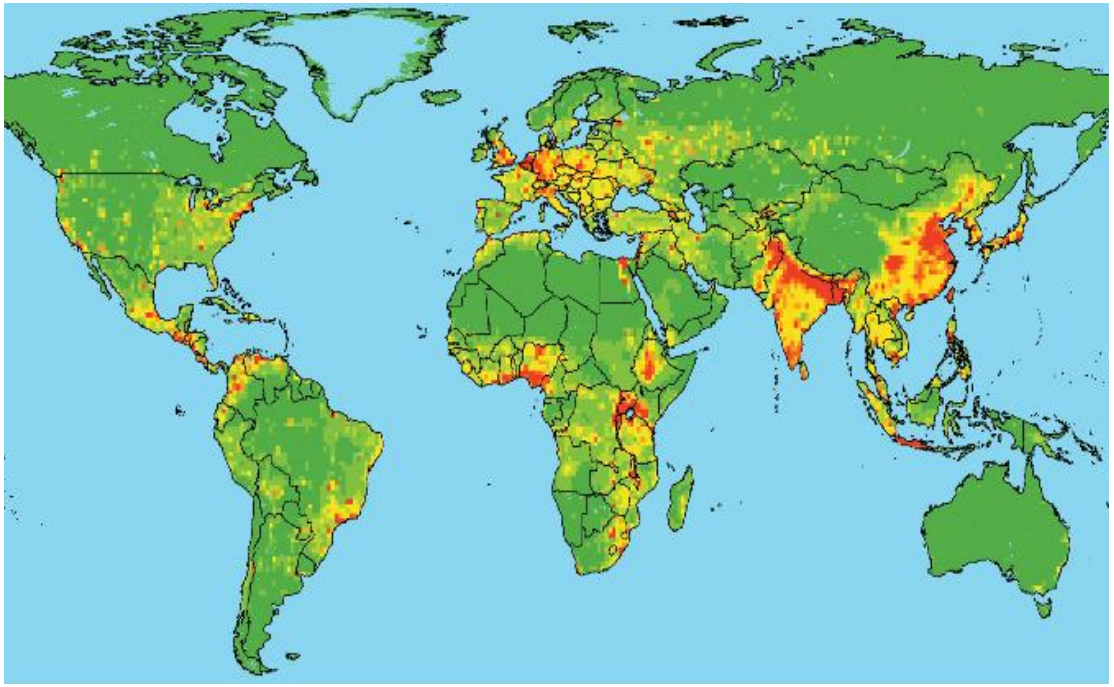
5. Wetlands International
6. ULB, LUBIES

Introduction

- Emerging Infectious Zoonoses 70% from wildlife
- Domestic/ Wildlife Interface
- Need for better estimation of transmission parameters



Global emerging zoonotic pathogens from wildlife hotspots
Jones *et al*, Nature, 2008

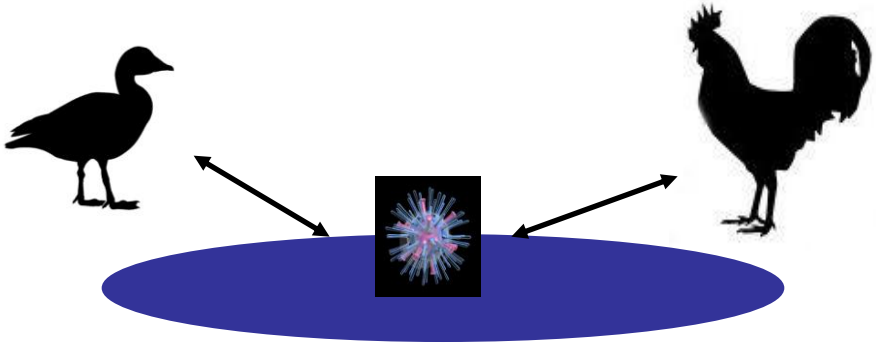
(β Transmission parameter comprises Contact rate and Transmission probability)

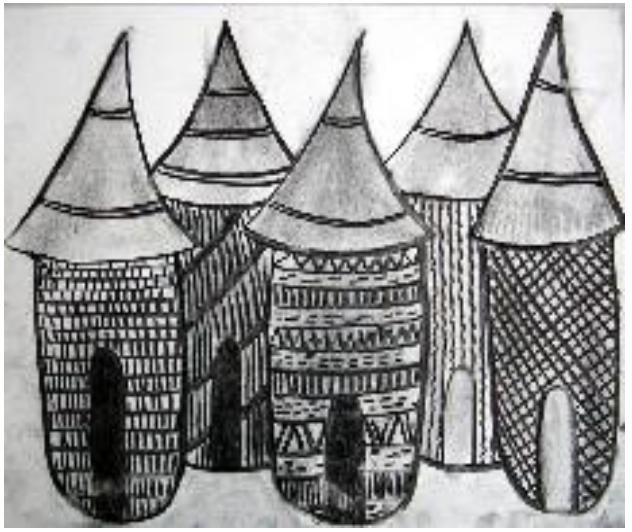
New technologies to estimate key parameters of disease transmission

At the wildlife-livestock interface in the tropics

Introduction

Evaluation of a key parameter of transmission dynamics



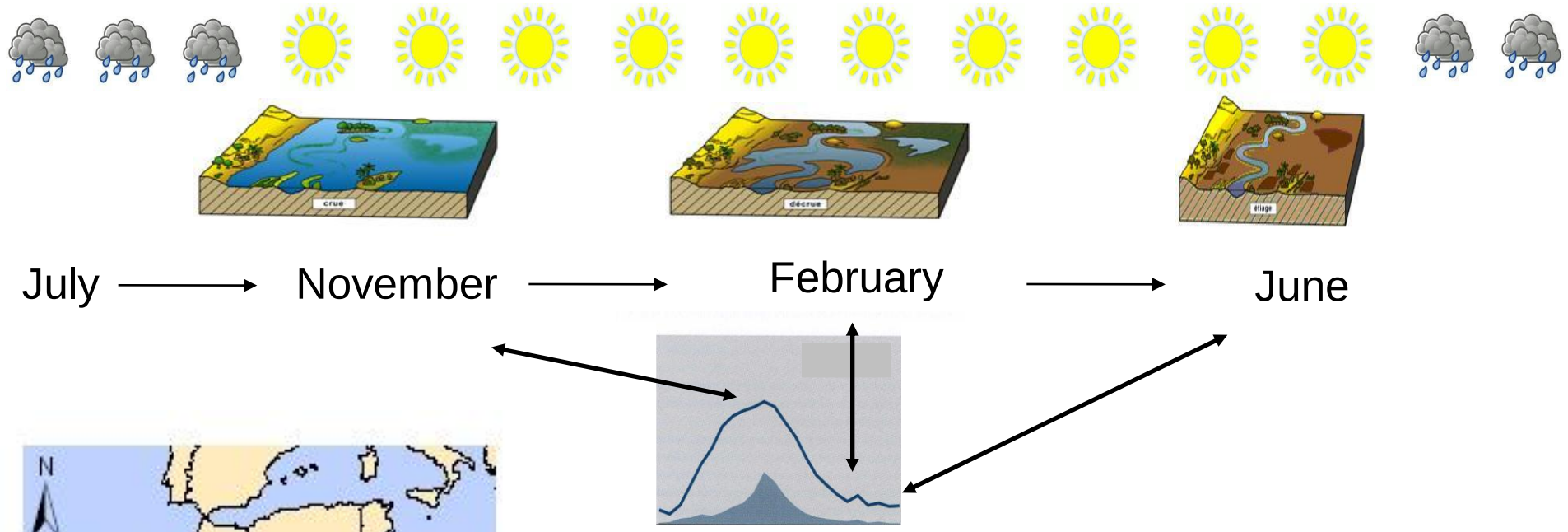


Potential of Indirect Contact Rate

Space = shared habitats between wild birds and poultry

Time = survival of the virus in the environment (e.g. AIV, NDV)

Introduction



Seasonal Variability

of flooded Areas

In the Inner Niger Delta

Objective

Evaluation of the potential of indirect contacts between Wild birds and Domestic poultry

Seasonal variability : successive 8-day periods

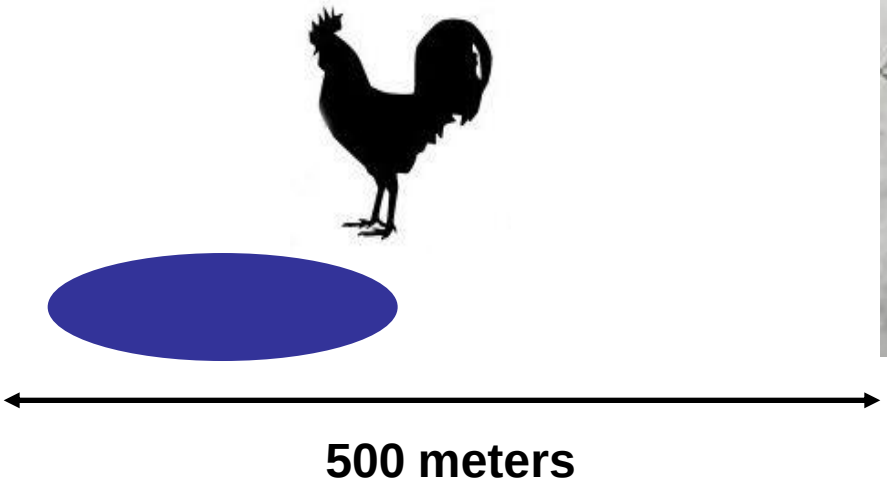
Poultry spatial Distribution

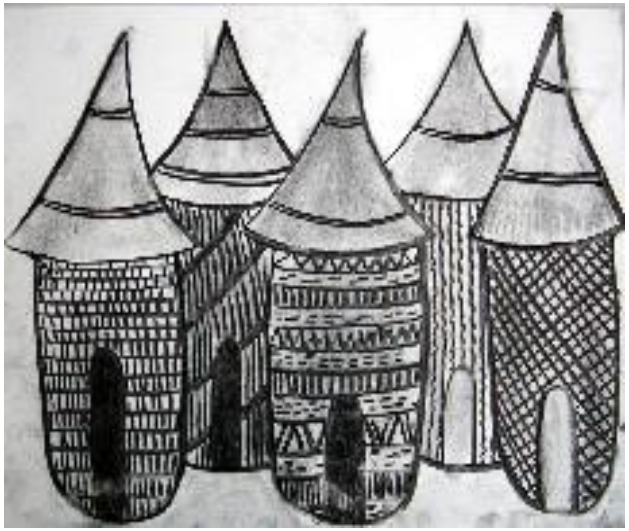
Wild birds spatial distribution

Correspondance of these two distributions during a period of time corresponding to the survival of the virus in the environment

Poultry Spatial Distribution

Field Investigation in villages

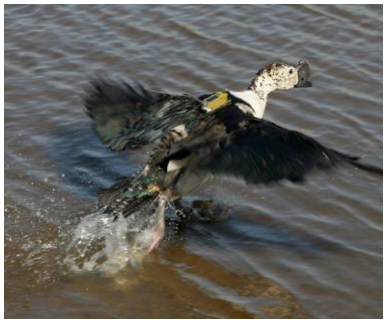


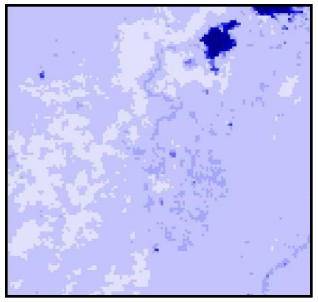


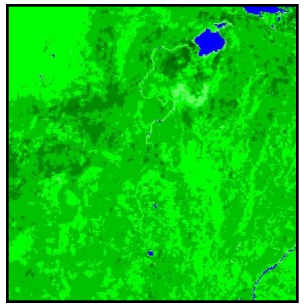
Poultry use habitats within a 500 meters distance from villages, daytime.

Village = Epidemiological Unit for Poultry

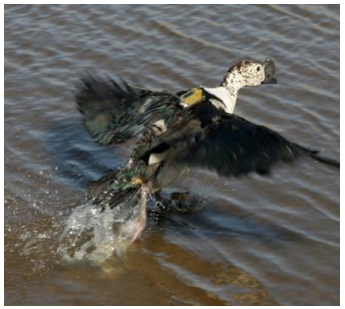
Estimation of the Wild Bird Spatial Distribution by combining Satellite Telemetry and Remote sensing







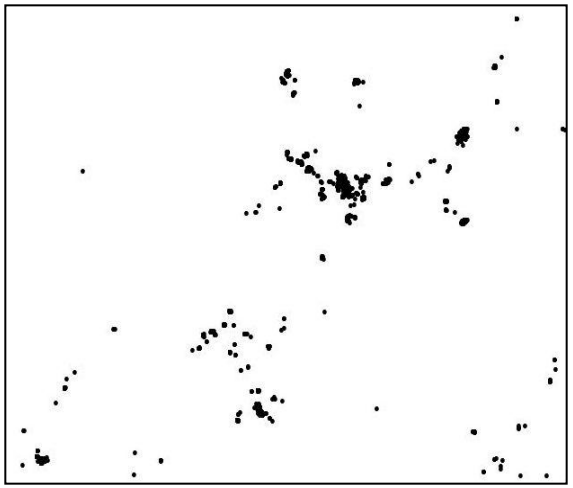
Wild Birds Spatial Distribution



Comb Ducks
73045
73046
73048
73049
Capture Site
Inner Niger Delta
Main lakes
Maximum Flooding area
Study area
64 Villages
Mopti
Mali
Burkina Faso
N
0
50
100 Kilometers

February → July

Wild Birds Spatial Distribution



> 5000 GPS locations

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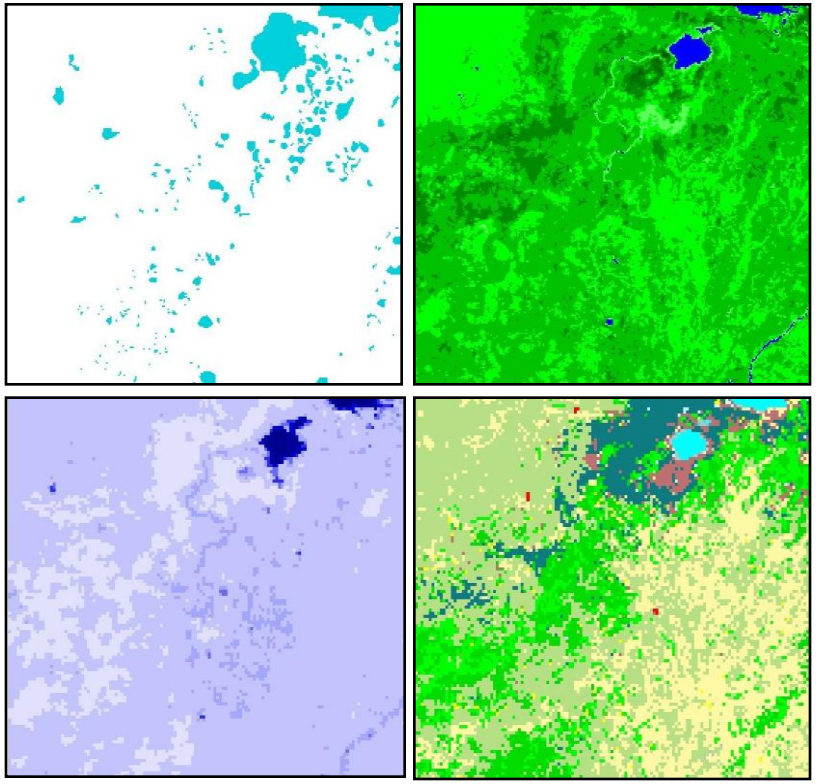


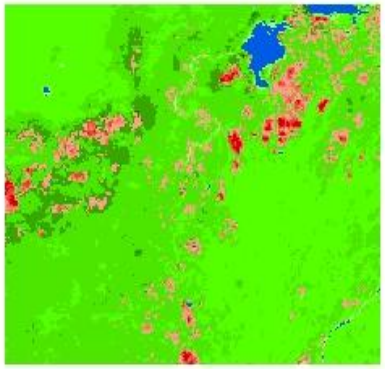
MODIS Indicators (NDVI, MNDWI)

Spatial distribution modelling using MAXENT

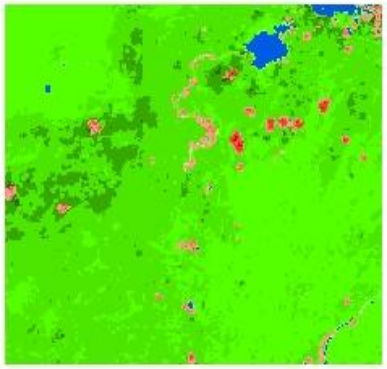
8 days Time Series

Wild Birds Spatial Distribution

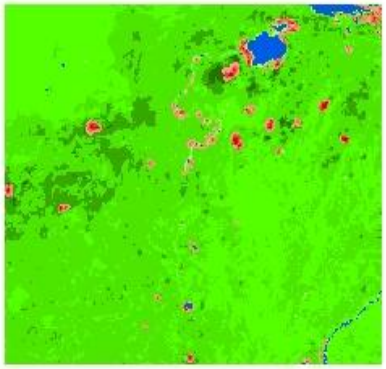
March 22 - 29



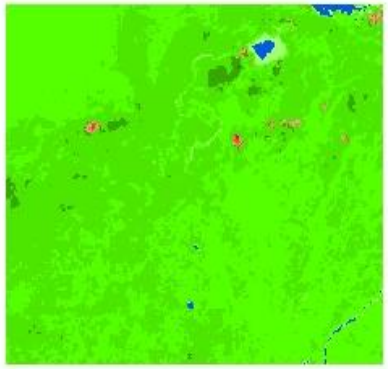
April 7 - 14



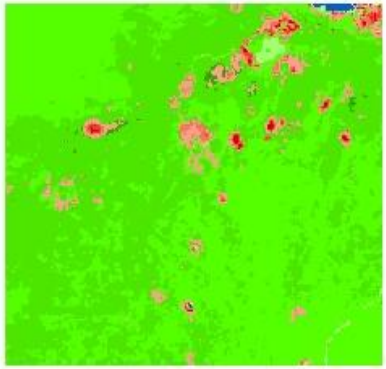
April 23 - 30



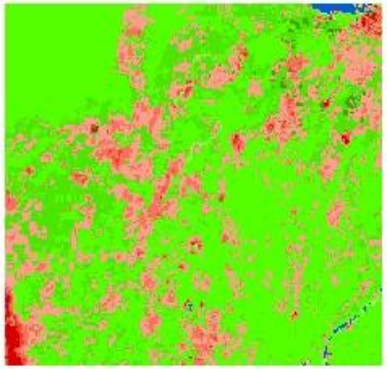
May 9 - 16



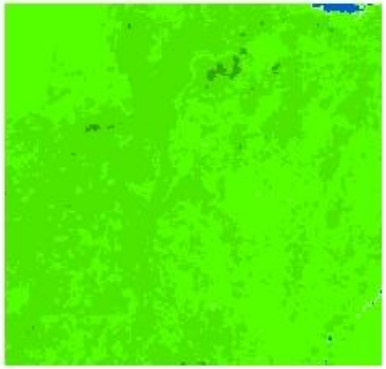
May 23 - 30



June 10 - 17



June 26 – July 4



N

NDVI

- 0
- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 1

Probability of presence

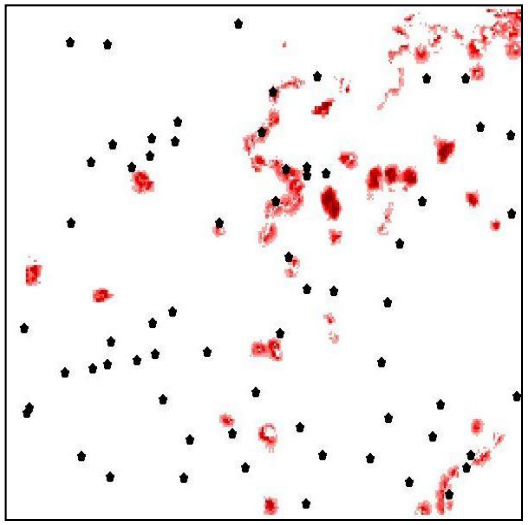
- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1

0 20 40 Kilometers

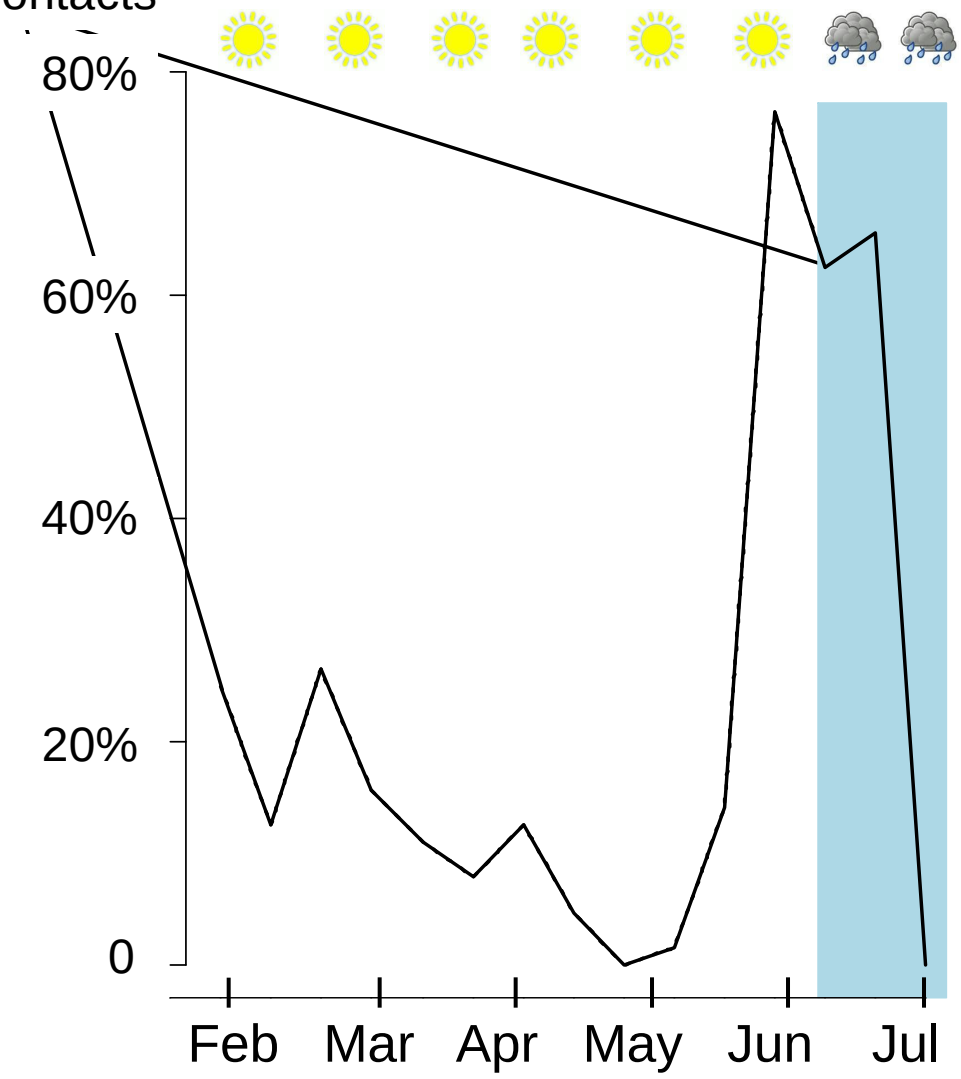
Results

Villages in potential contact with Comb Ducks

- Villages (n=64)
- Comb Duck Distribution



10 km



Persistence of AIV, NDV > 24 hours

Discussion

- **Evaluation of the seasonality of potential indirect contacts between Poultry and Comb Duck**

  -Potential indirect contacts in the vicinity of villages

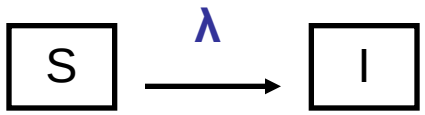
  -Quantification of the potential contacts

  -Seasonal variation of the potential contacts

Discussion

- **Representativeness of the wild bird distribution?**
  - **Gregarious species**
  - **Validation points of the model from observation on the field**
  - **No extrapolation to other areas**

- **Contact ≠ Transmission**
  - **AIV : No Transmission risk in June-July**
  - **NDV : Transmission risk in June**



$$\lambda = \beta . I$$

$$\beta = - c \log (1- \rho)$$

λ = Force of Infection
β = Transmission parameter
c = Contact rate
ρ = Transmission probability

Discussion

Combination of Remote sensing and Satellite telemetry

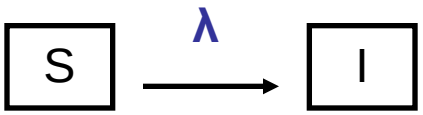
→ Use of New technologies for a better evaluation of transmission parameters

Future Research Needs

Direct Estimation of key Transmission parameters (Telemetry, Molecular Biology)

→ Feed mechanistic models (SIR models, graphs, IBM)

→ Take into account different spatial and temporal levels



$$\lambda = \beta . I$$

$$\beta(t) = - \alpha(t).c \log (1- \rho)$$

λ = Force of Infection
β = Transmission parameter
c = Contact rate
ρ = Transmission probability
α = Seasonal variation measured on the field

Thank you for your attention

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