Quantitative Risk Assessment to improve Farm Biosecurity: Wildlife-Cattle Transmission

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Objective

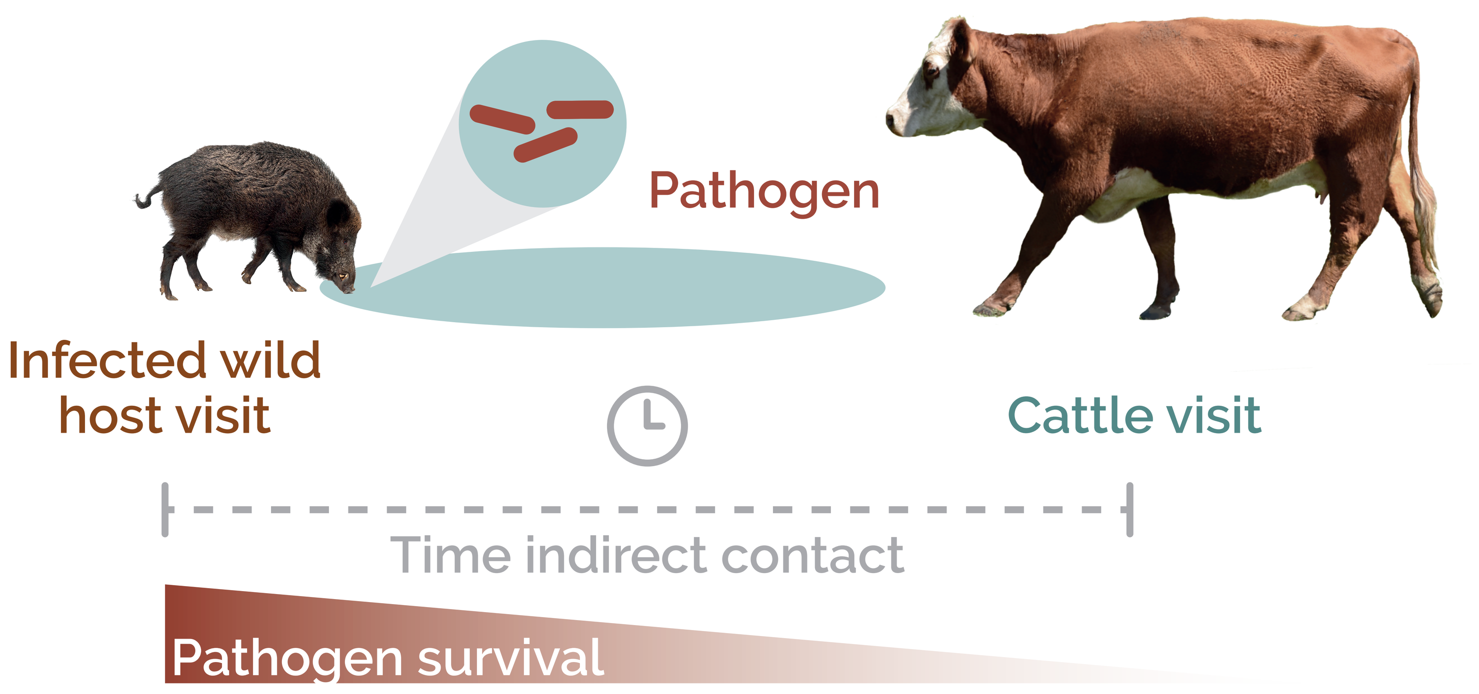
To develop a **quantitative risk analysis** model for indirect transmission of pathogens between wildlife and cattle to **assess the impact of biosecurity** measures on risk points.

Context

The implementation of **biosecurity measures** against environmentally resistant, multi-host pathogens (such as tuberculosis) is a challenge in **extensive farming**.

Risk: Indirect transmission

Water and feed are the main risk points for indirect transmission of pathogens between wildlife and cattle.

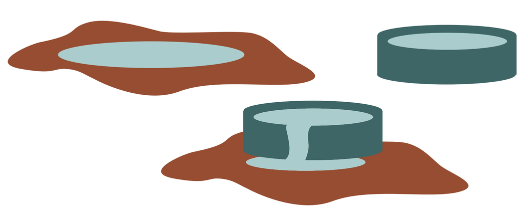


What can we do to reduce risk?

REDUCE
Pathogen survival

e.g. Avoid waterloged or muddy points

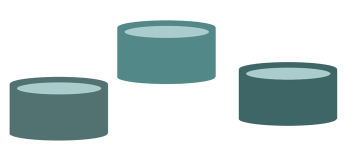
Use and maintain wateres



INCREASE
Time indirect contact

e.g. Reduce number of visits per waterer

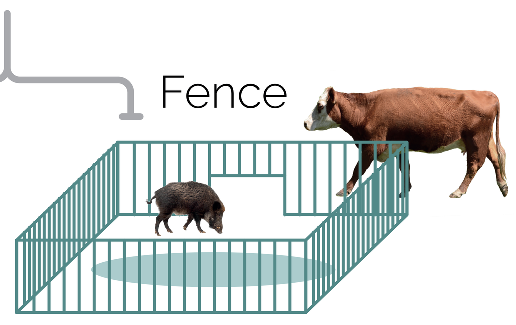
Increase number of waters



Restrict access

Heigth <90cm

Fence



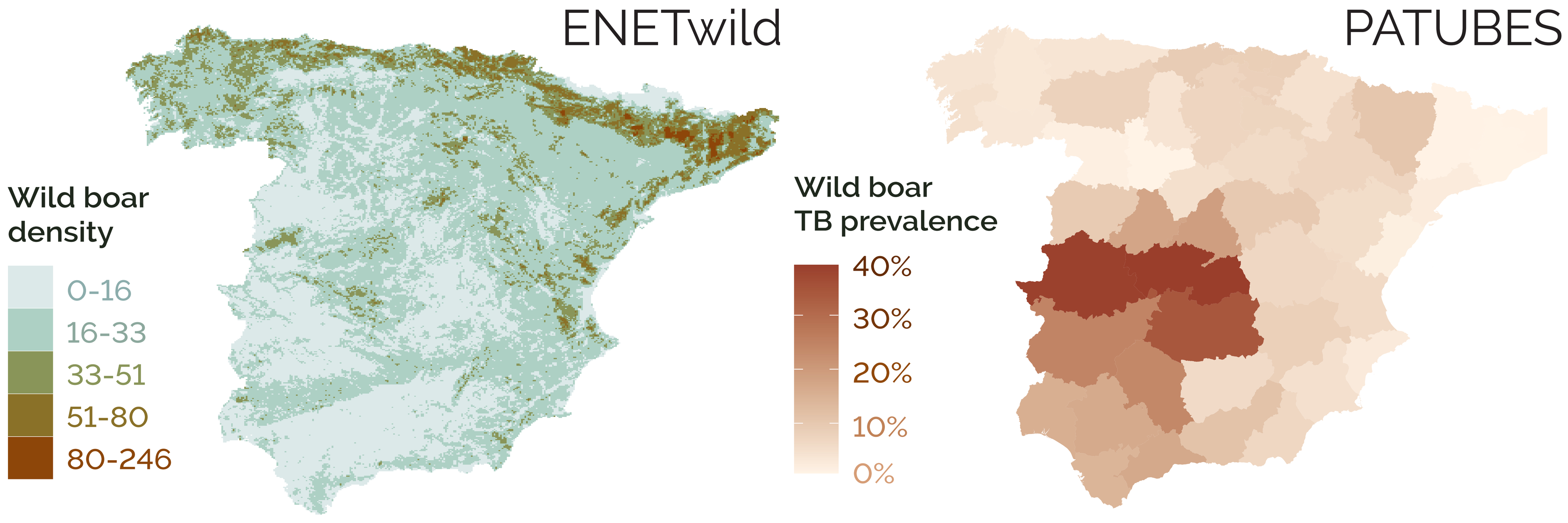
Farm-specific approach

The model uses on-farm biosecurity surveys and geospatial data to assess risk in each specific context.

On-farm survey

Risk points: number, access, type (river, waterer...), mud...

Wildlife surveillance



Risk analysis

Model parameters

Wild host
Disease prevalence p
Visit probability w

Cattle
Visit probability c

Pathogen
Survival curve s_0, k
Transmissibility i

Model steps

1 Probability of infected wild host visit

$$w_{inf} = w \cdot p$$

2 Probability of time t of indirect contact

$$f(t) = \frac{d}{dt}\left[\left(1-(1-c)^t\right)\left(1-(1-w_{inf})^t\right)\right]$$

3 Probability of pathogen survival

$$s_t = log((10^{s_0} - 1) * e^{(-k*t)} + 1)$$

4 Probability of infection in cattle

$$c_{inf} = s_t \cdot i$$

Compare biosecurity scenarios

The risk of infection is quantified for "what-if" scenarios to assess the impact of biosecurity measures.

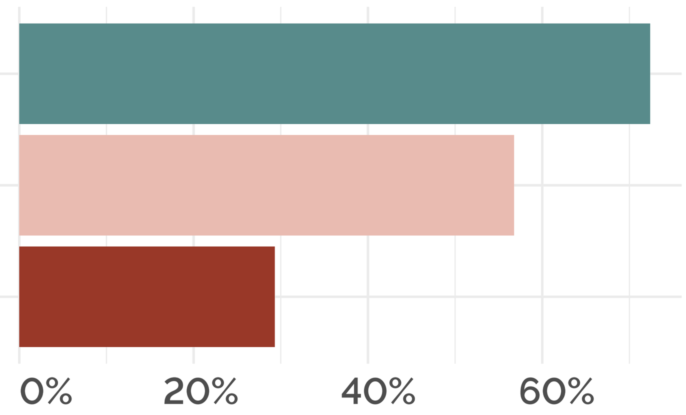
Annual probability of indirect transmission at a water point

Scenario	5%	25%	50%	75%	95%
One waterer with mud	0.00089%	0.070%	1.14%	7.10%	22.81%
No mud arround the waterer	0.00045%	0.050%	0.86%	6.36%	22.73%
Add two extra waterers	0.00021%	0.030%	0.59%	5.54%	21.76%
Add two extra waterers + No mud arround the waterer	0.000092%	0.020%	0.39%	4.65%	20.30%

Discussion and further steps

- By modeling the risk of disease entry through wildlife interactions, this study aims to develop feasible biosecurity plans adapted to the extensive farm context.
- The model has limitations, such as estimating pathogen prevalence in wildlife and visit frequency from fragmented data, but it aims to balance complexity and applicability for useful biosecurity assessments.
- This model will be extended to other risk points, pathogens and animal species. It will be part of a general biosecurity assessment model and tested on real farms.

Risk reduction of suggested biosecurity measures



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