Predicted changes in herd immunity levels against Rift Valley fever virus in livestock following a natural exposure

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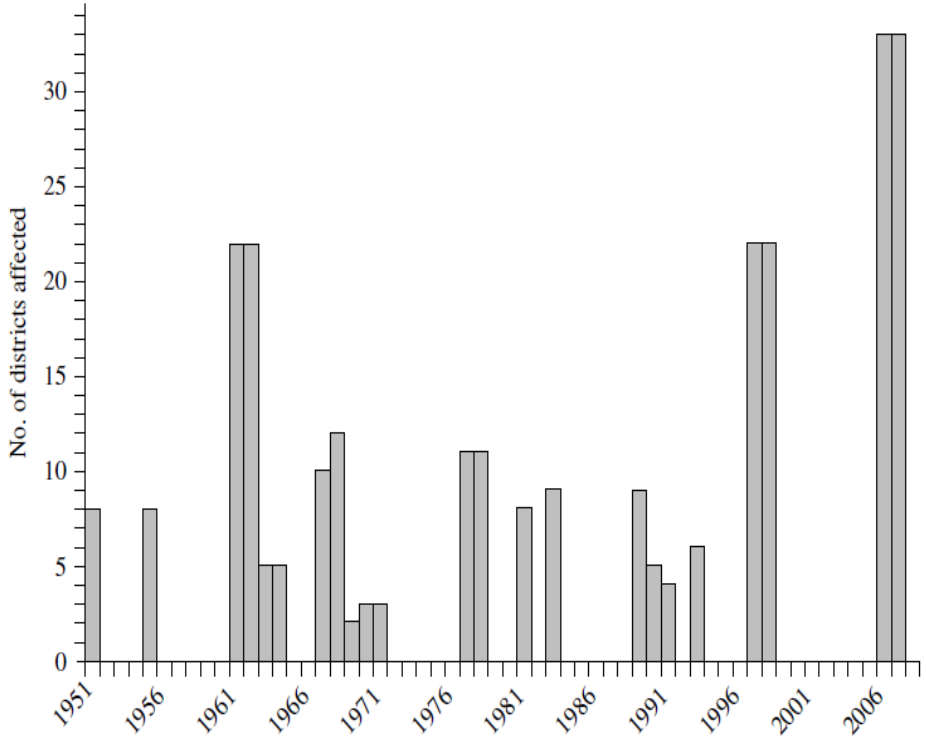
Rift Valley fever (RVF) herd immunity dynamics

- RVFV transmission gets elevated following periods of excessive and persistent rainfall

- Average inter-epizootic period in Kenya estimated to be 3.6 years (range 1–7 years)



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Rift Valley fever (RVF) herd immunity dynamics

- Hypothesis: herd immunity plays an important role in modifying the length of inter-epizootic intervals

- i.e. risk of an epizootic intensifies when herd immunity is low.

- Senegal: epizootics associated with loss of herd immunity over a 5–7-year inter-epizootic period

Objective

To evaluate the relationship between herd immunity and RVF virus transmission dynamics

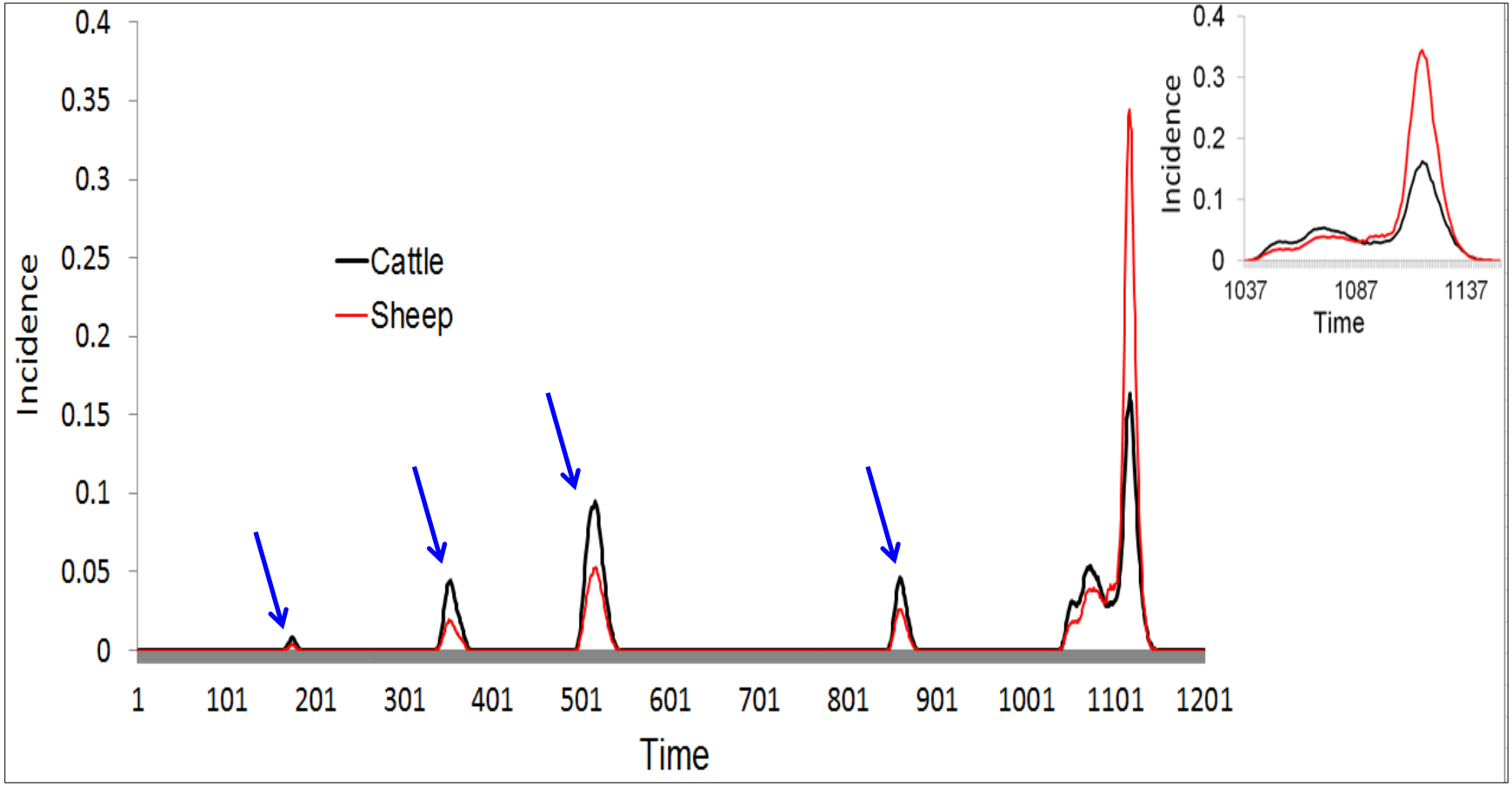
RVF virus transmission model

Vector to host transmission

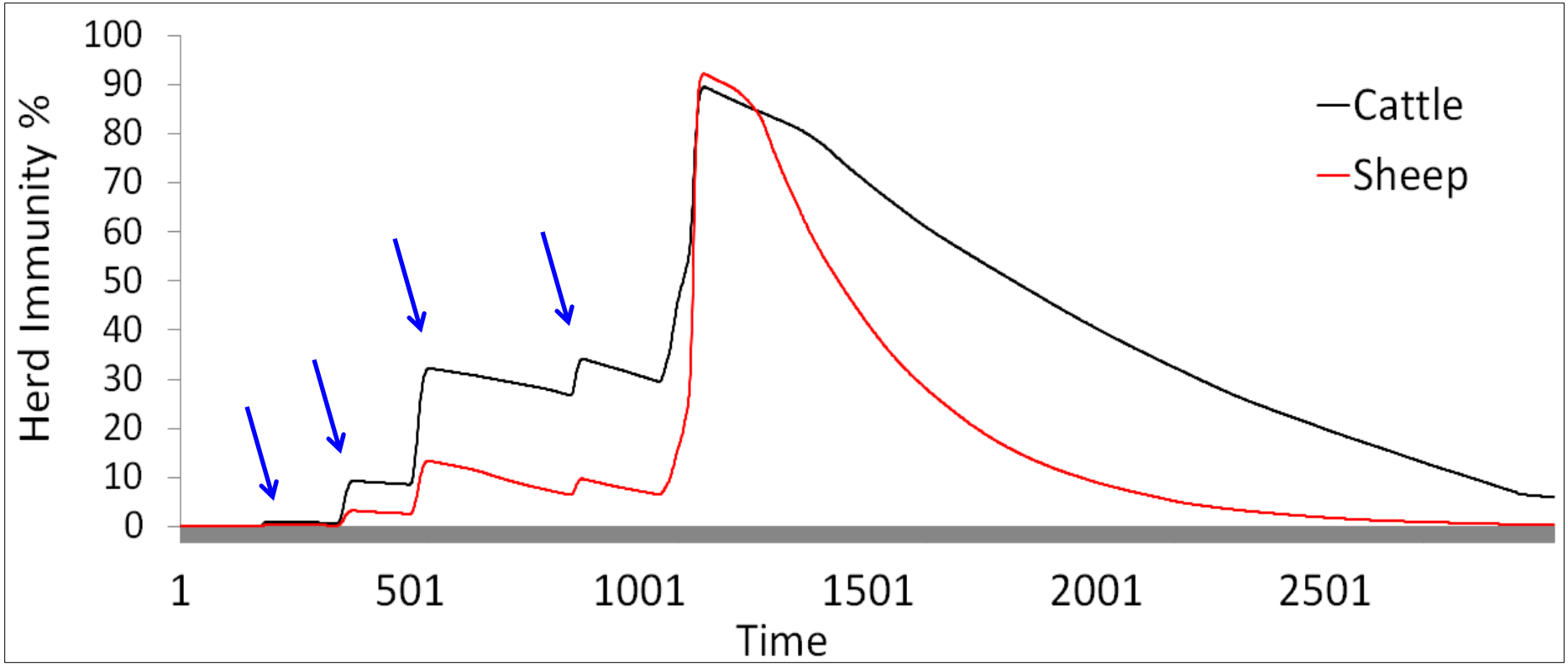
Host to vector transmission

Following the predicted outbreak, we prevent further transmissions and run simulations for five years to assess the evolution of herd immunity patterns.

Model prediction - transmissions



Herd immunity patterns



seasonal/inter-annual transmissions boost herd immunity

Seasonal/inter-annual transmissions

- These inter-annual transmissions might be responsible for sustaining herd immunity over time, especially when there are no external shocks associated with droughts, migration and tribal animosities.

Herd immunity patterns

- High herd immunity levels at end of the outbreak
  - 89.3% in cattle [range 80.5 - 96.2%]
  - 91.9% in sheep [range 64.5 - 99.4%)
- Five years later, the herd immunity levels decline
  - 5.9% in cattle [range 4.2 - 7.9%]
  - 0.26% in sheep [range 0.07 - 0.5%]
- The rate of decline is intensely higher in sheep than cattle

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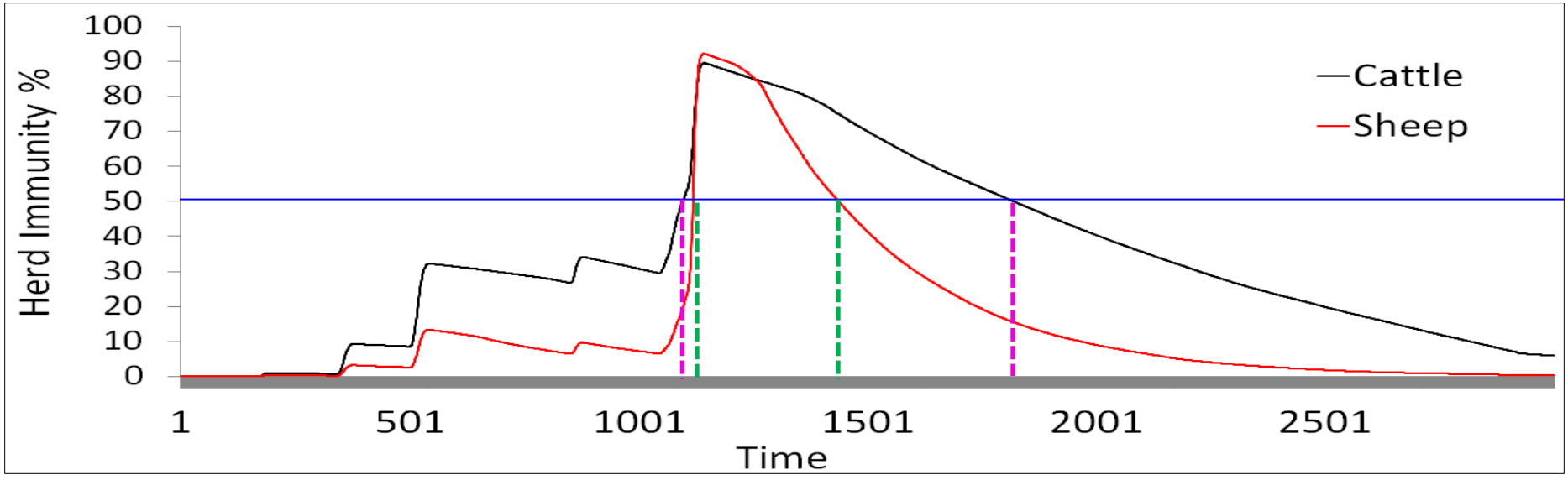
Modifying the length of inter-epizootic intervals



- Other model analyses – 50% herd immunity sufficient to prevent a full-blown outbreak
- Predicted full-blown outbreak prevention window range
  - Average 317 days in sheep
  - Average 723 days in cattle

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Modifying the length of inter-epizootic intervals

- Average herd immunity in the population declines to 50% in between these ranges (317 – 723 days)
- Predictions suggest that host diversity can influence the temporal pattern of a multi-host epizootic
- i.e. at a given time, assuming a single species host population and suitable climatic indices, full-blown outbreaks may either occur or not

Interpretation

- Findings provide a better understanding of immunity patterns critical in refining existing control strategies aimed at boosting herd immunity during the inter-epizootic period.

- Findings provide huge potential for use in evaluation of cost-effectiveness of vaccination campaigns.

Thank you