

# Challenges in Animal Infectious Diseases Modelling

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some insights from working on diseases in species that come out at night....

# Collaborators & Funders



- Dept. Vet Med, Cambridge
  - Andrew Conlan
  - TJ McKinley
  - Olivier Restif
  - Ellen Brooks-Pollock
- AHVLA
  - Glyn Hewinson
  - Martin Vordemeier
  - Mark Chambers`
- Imperial College
  - Christl Donnelly

- Institute of Zoology
  - Andrew Cunningham
- AHVLA
  - Tony Fooks
- STEPS Centre, IDS Sussex
  - Melissa Leach
  - Linda Waldman
  - Hayley MacGregor
- University of Colorado
  - Colleen Webb
- Ghana Wildlife Division
  - Richard Suu-Ire
- University of Ghana
  - Yaa Ntiamoah-Baidu



# Narrative and Questions

- Who makes policy in animal health?
  - Government
  - Industry bodies
- How is policy made within government?
  - What is the question?
  - What is the answer to the question?
  - How can challenges of timing be dealt with?
- Who makes policy within government?
  - Policy teams v technical teams v scientific advisors v politicians
  - What pressures?
- Policy in international animal health..
- ‘Policy’ for non-statutory diseases

# Background approach to engagement with policy & impact?

- Identify different national, international, policy, funder, scientific and lay stakeholders, beneficiaries
- Consider questions prior to starting research with key stakeholders
- Consider how best to engage with each
- Can be formally undertaken in PIPA\* exercise at project inception

\*participatory impact pathways assessment: see [wiki](#)  
Collaboration with Melissa Leach,  
ESRC STEPS Centre at Institute for Development Studies  
at University of Sussex

# bTB starting point – personal perspective

- Involvement in research project on bovine TB
  - Process started with identifying the question
    - what defines a ‘problem herd? (infection persistence)
    - Significant stakeholder involvement
  - Determine the combined statistical and mathematical modelling approaches
    - What factors are associated with problem herds?
    - What drivers of persistence are evident from careful analysis of available data – and process-based mathematical model fitting to data
- Led to definition of what to expect, as much as what you can do, to impact disease control

# Analysis and within herd models of bTB

- 50% of breakdowns recur within 3 years
- Prolongation associated with testing programme / 'confirmation'
- Substantial burden of infection residual in herds after controls are lifted (shown by recurrence)
  - Demographic turnover loses much of this!
- Clear evidence of transmission within herds from infected cattle
  - not just an infectious disease of badgers
- Substantial infection pressures from outside herds
  - Varied substantially depending on background geographic risk
  - Could be cattle, wildlife, etc etc

# How were our results interpreted?

- (cautiously by us!)
- ‘Look – all the problem is in the cattle’
- ‘Look – all the problem comes from outside the herd (so it must be badgers)’
  
- From us: policy relevant publications and further grants
  - Submission of ‘concept note’



## work led naturally on to...

- Studies of vaccination impact within herd
  - Models of testing as important as models of transmission
- Involvement in design of potential cattle vaccination field trials

# Parallel natural science studies

- Demography and bovine TB
  - Ellen Brooks-Pollock
- Spatio-temporal statistical models of transmission
  - TJ McKinley
- Spatial network models
  - Warwick, Glasgow
- Other within herd models
  - Glasgow
- Badger related work +++++

In parallel.....

# **BADGER CULLING DEBATE**

# What is the likely impact of cattle v badger controls

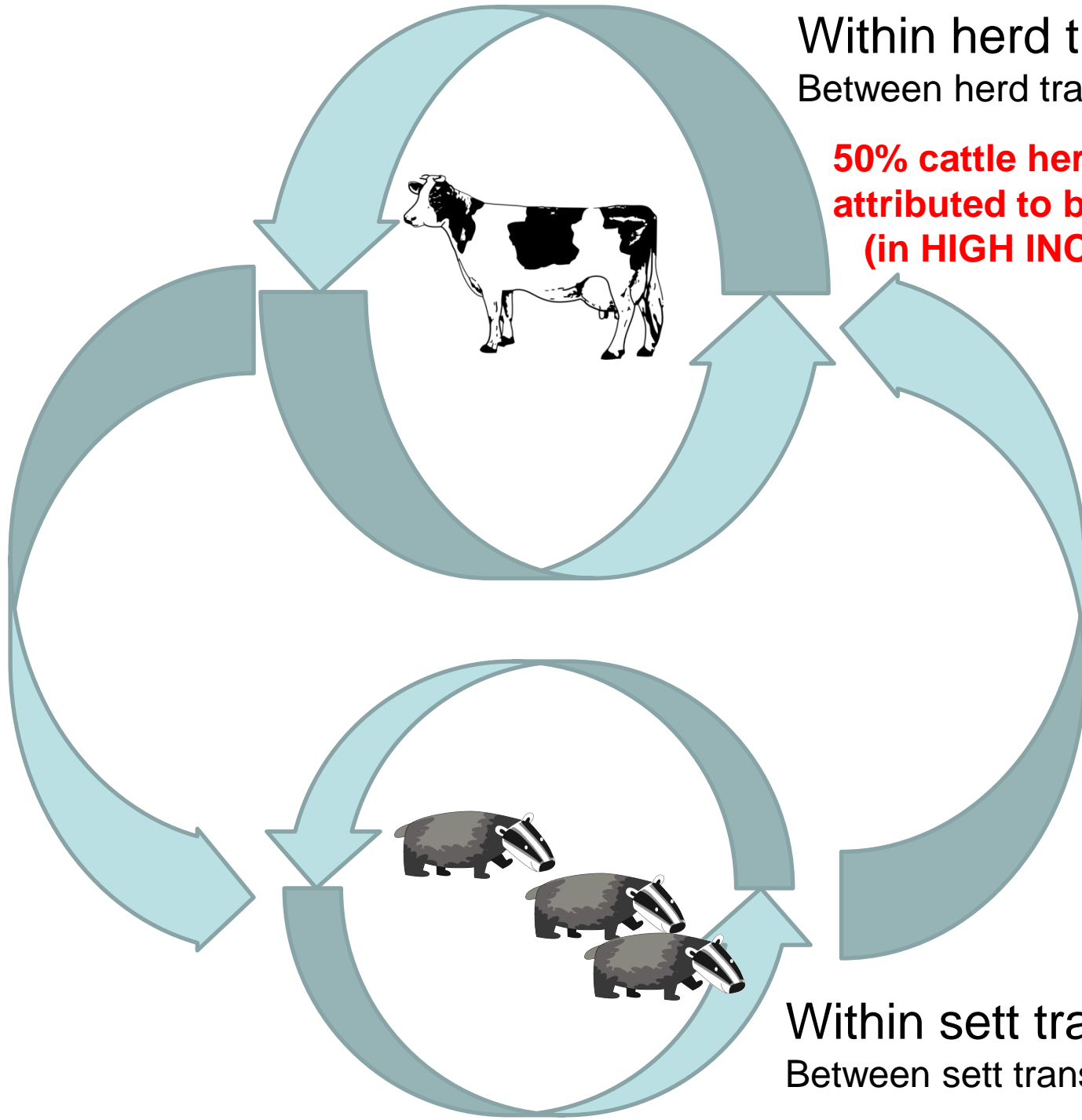
- What model framework can address this?
- How should it be parameterised?
- How do you determine impact?
- Over what timescales should impact be expected?

But then The model didn't work.....

# Isn't it easy?

- What is framework?

Cattle to badger transmission  
*(never estimated)*



Within sett transmission  
Between sett transmission

Donnelly, various

# Isn't it easy?

- What is framework?
- “Should be possible within short period”
  - ‘Just look FMDV with best groups involved’
  - ‘academics need to get engaged’ (sic)
- BUT: How can models be fitted when there are major data gaps?
- What does government need from model format in order to use them?
- (ongoing, key involvement of Rowland Kao)

# Compare historic AI and FMDV approaches

- Modelling approaches which are perceived to have functioned well for Defra
  - Real time modelling for FMDV
  - Funded programmes in several groups for AI
- Relatively simple rapidly spreading epidemic diseases
  - Location and movement drive transmission process
  - No significant wildlife issues



# Timing

- Policy timescales
- Modelling timescales
- Model development timescales
  - Dealing with over-promise of others....

# Next round studies - 1

- Within herd vaccination grants
  - Cambridge and Imperial
  - Different focus
- Used vaccine data from previous studies
  - Carefully considered
- Identified that DIVA test characteristics more important than efficacy in driving cost benefits

# Next round studies - 2

- Answer didn't fit experiences elsewhere
  - 'Data must be wrong'
  - 'We have other datasets'
- Planning vaccine trials
  - Trial of DIVA and safety as much as of vaccine efficacy

# Who makes policy within government?

- Politicians
- The gun lobby
- Advisory groups who put their name on strategy documents
- TB policy team
- Technical / veterinary advisors
- Defra Science teams

# International AH policies - TRADE

- Governed to great extent by written agreements (OIE, FAO, WTO)
- Opaque role of OIE and its member states and their interests
  - Different types of ‘expert’ statements
- Increasingly significant role of EFSA within European Community
- Unclear that modelling has much role

# The role of industry in AH policy

- Many diseases not controlled by statutory regulation
- Need for industry driven measures
- Variably informed by modelling
- Policies may be easier to implement than in government
- ‘Regulation’ or implementation differs markedly between industries
  - Species differences in farming
  - Equine v. companion animal v. food animal species

# ‘Pathways to impact’

- PIPA-type Approaches
  - (STEPS Centre, IDS, etc)
- Engagement of policy and stakeholders from early stage
  - Does not need to impact on science quality
  - Does not need to subvert scientific process
  - Helps to identify mismatched expectations

