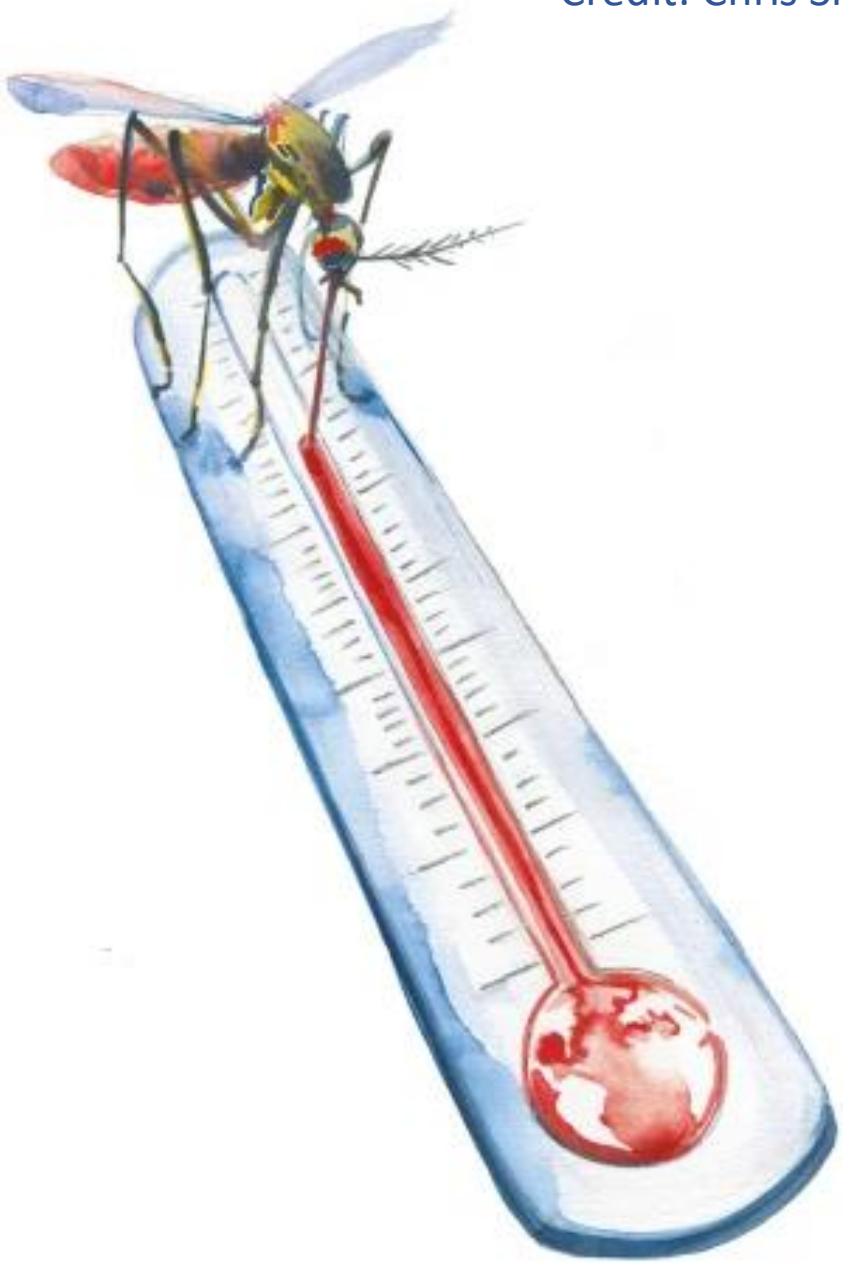
# Vector Borne Diseases

Intersection of disease transmission and environmental change

Credit: Chris Sharp



Catherine Oke

Keith Matthews

Amy Pedersen

Sarah Reece

Hilary Snaith
EID@ed.ac.uk

**Thanks also to**

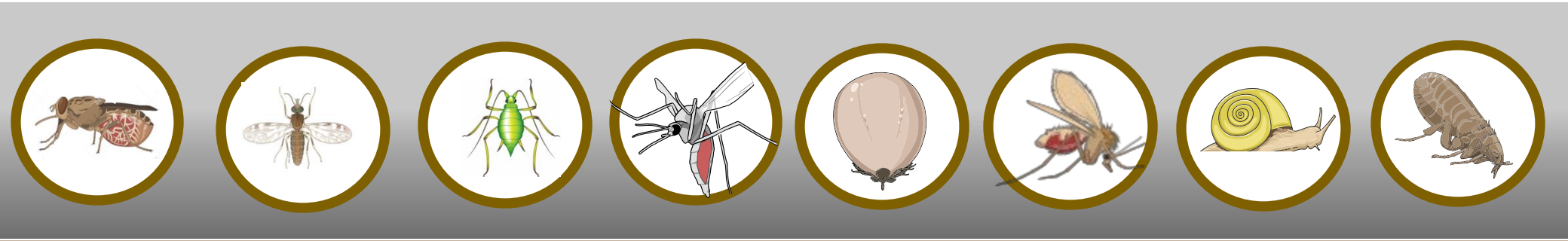
- Liv Coombes
- Kirsten Paterson
- Dora Lola-Luz

Edinburgh Infectious Diseases

Proudly supported by THE UNIVERSITY of EDINBURGH

## Aims & Rationale

- VBD research in Edinburgh (UoE & Moredun)
- Identify strengths, gaps and opportunities
- New collaborations and approaches



## Ideal Outcomes

- Ideas & teams for funding bids, thematic groups
- How to support groups / teams
- How to ensure sustainability of facilities / resources
- How to lobby funders for our strengths

# Funding landscape

- Funder strategic themes including:
  - Tackling infections, climate change, building secure and resilient world, green space and natural environments, infectious disease, food security
- Previous opportunities:
  - Specific awards for understanding disease spread
    - E.g. Wellcome – Dengue/Zika, up to £5 mill, all aspects
  - UKRI-Defra
    - Forecast, understand, mitigate and avoid vector-borne disease threats to the UK using One Health approach.
      - Partnership with UK Gov organisations **strongly encouraged**
      - Multidisciplinary teams requested
      - Previous funding for VBD hub to Imperial (Lauren Cator, 2023)

# Funding landscape

- Team grant opportunities
  - **Research:**
    - Wellcome Trust Climate Impact Awards
      - Details of new call released 6 February 2025
    - UKRI Tackling infections: strategic theme
      - Phase 2: Gap-filling and augmentation programme that builds on Phase 1 – To be announced
    - ERC Synergy grants (2-4 PIs, can apply from same institute)
      - Collaborative working, **multidisciplinary projects strongly encouraged**
  - **Networks:**
    - EU COST Actions
  - **Training**
    - EDCTP3 Fellowships, DTP
- Lots of AI-related funding calls…

# Funding opportunities

## Wellcome Trust Climate Impact Awards

**Aim:** generate context-specific evidence using community knowledge and experiences to deliver actionable policy outcomes that can be scaled to multiple settings

- WT "will prioritise research **that involves and serves the needs of communities most impacted by the health effects of climate change,** and advances stories and narratives that tend to be absent in the media or underrepresented in public discourse"
- Short-term, high impact, **transdisciplinary** projects to **maximise policy outcomes**
- Up to 8 co-applicants, unlimited collaborators
- **>£2.5M,** up to 3-year projects, evidence gap identified in 12-18 months
- Deadline: **30 April 2025;** webinar 3 March – sign up on website
    - https://wellcome.org/grant-funding/schemes/climate-impacts

# Funding opportunities

## Wellcome Trust Climate Impact Awards

In scope

- Proposals where the primary focus is on the current or future direct & environmentally mediated physical or mental health outcomes attributable to climate change
- a clear policy pathway to influence change
- an engaged research approach with key stakeholders identified (including a communication strategy)

Out of scope

- Socially mediated health effects (such as migration and livelihoods)
- Current or future health effects attributable to the consequences of climate change action (mitigation or adaptation).
- Current or future health effects attributable to the drivers of climate change (for example, fossil fuel emissions).

# Funding opportunities

## EU COST Actions

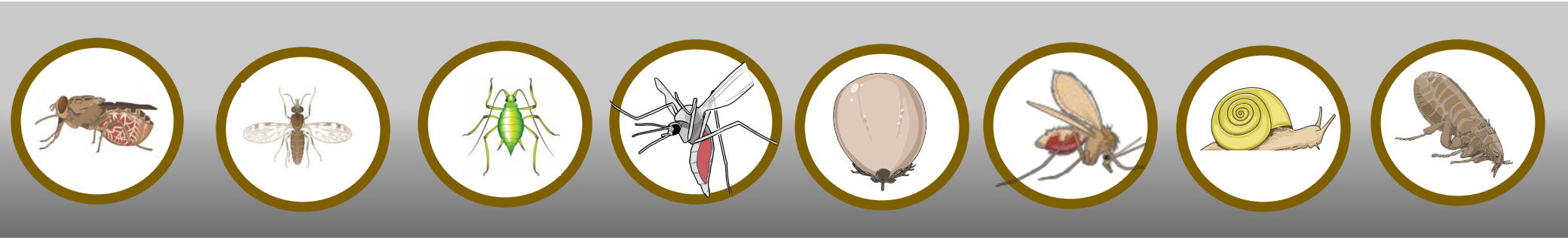
- Bring together researchers, innovators and other professionals including industry specialists, who are based in Europe and beyond, to collaborate on research topics for a period of 4 years
- Approx €125,000 funding for first year and average of €150,000 per year for the other 3 years
- Support meetings, conferences, workshop, short term scientific missions, training schools, communication and dissemination activities
- Must including researchers from at least seven COST Member countries, half of whom come from EU Inclusiveness Target Countries
- Deadline: 21 October 2025

# Funding opportunities

## Horizon Europe EDCTP3 fellowships

- Establishment of an African cohort of **epidemiologists, biostatisticians, infectious disease mathematical modellers** by supporting institutions in sub-Saharan Africa and Europe that provide Master's training
- Proposals submitted should:
  - Increase the number of skilled epidemiologists, biostatisticians, and infectious diseases modellers in SSA;
  - Promote the career development and retention of skilled personnel in SSA;
- €6.7M in total, 5 programmes expected (€1.34M ea)
- Deadlines – Stage 1: 20 March 2025; Stage 2: 2 September 2025

# Research intros

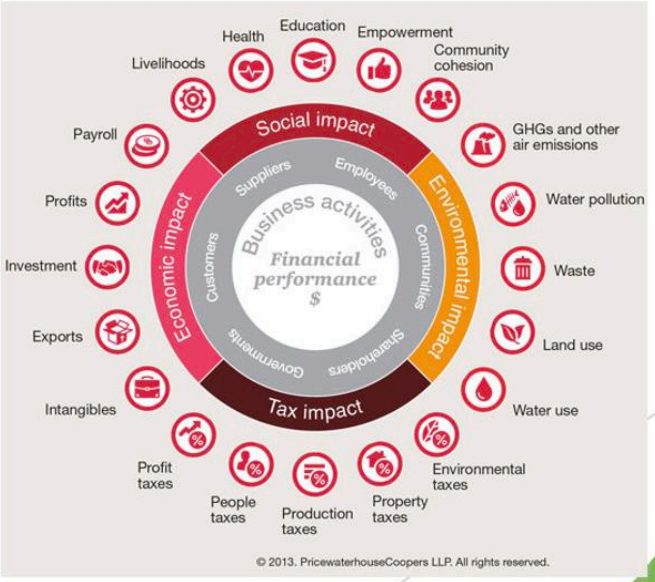


Iris Bosa

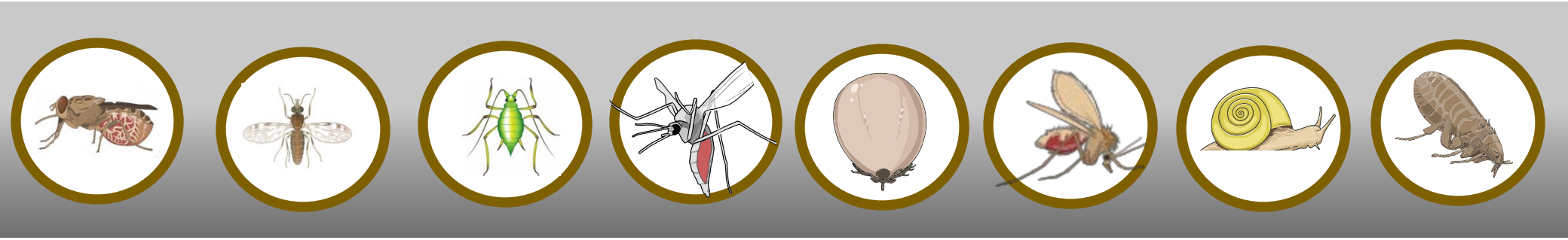
My interest is on
-**healthcare systems** and the pressure on them, but I can also contribute with a
-**management accounting** angle in supporting the process of determining the costing of direct and indirect and induced, i.e. output and outcome.

- With several Italian colleagues we wrote: Giannoni, M. *et al*. (2023). **The Coronavirus Pandemic and Inequality in Italy**. In: Johnson-Lans, S. (eds) The Coronavirus Pandemic and Inequality. Global Perspectives on Wealth and Distribution. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-22219-1_5

And I like this representation:



# Research intros

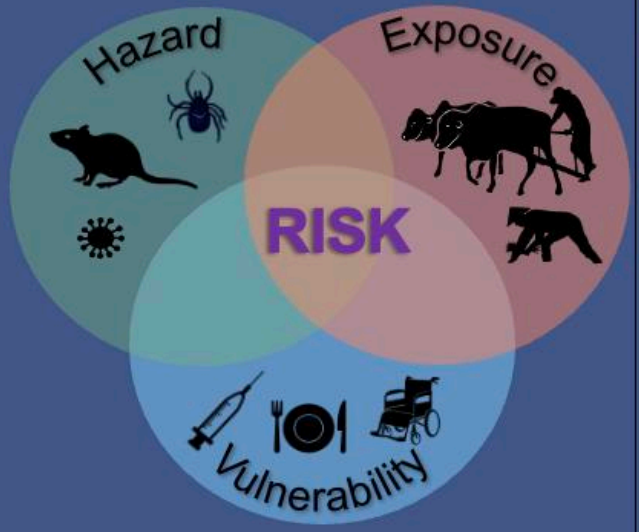


Sarah Burthe

# Sarah Burthe, Biodiversity and Landuse, UKCEH

## Research topic – Impacts of environmental change on VBDs

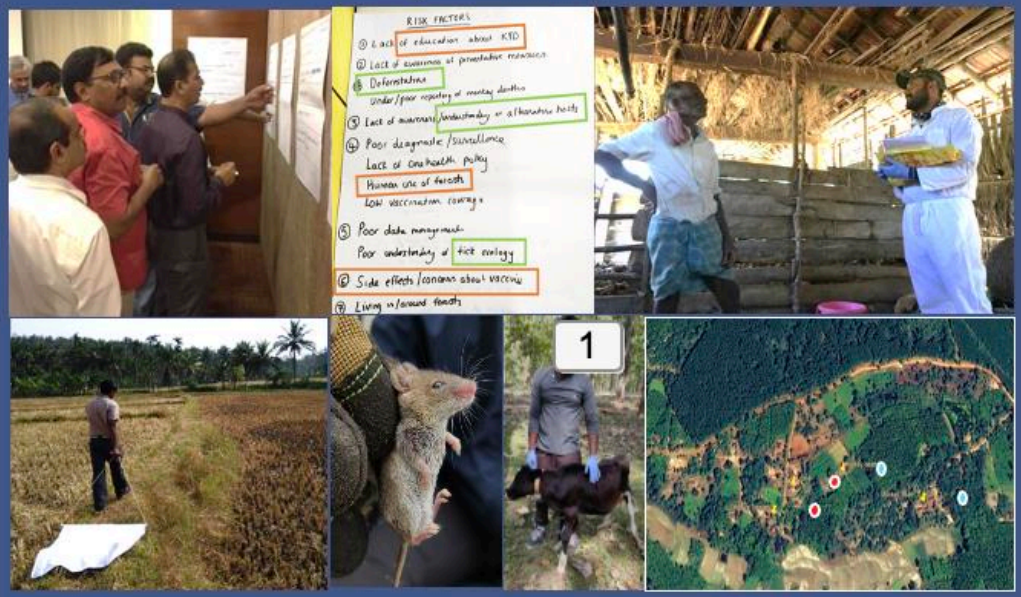
### What are the socio-ecological factors driving human vulnerability to zoonoses




Keywords: Onehealth, deforestation, climate change, neglected zoonoses, interdisciplinary approaches, ticks, Kyasanur Forest disease, India

UK Centre for Ecology & Hydrology

## Approach – co-production to frame research & produce tools for managing disease. Empirical socio-ecological surveys across broad areas, R0 & Agent based models




Keywords: earth observation, social science, disease ecology, stakeholder, policy guidance, focal groups, household surveys, spatial risk maps, R0 & ABM models

## Key projects:

MonkeyFeverRisk

India Zoo Risk

0

PLOS NEGLECTED TROPICAL DISEASES

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Using mechanistic models to highlight research priorities for tick-borne zoonotic diseases: Improving our understanding of the ecology and maintenance of Kyasanur Forest Disease in India

Richard M. J. Hassall, Sarah J. Burthe, Stefanie M. Schäfer, Nienke Hartemink, Bethan V. Purse

Key questions: What are the key vectors and hosts involved in KFD transmission?

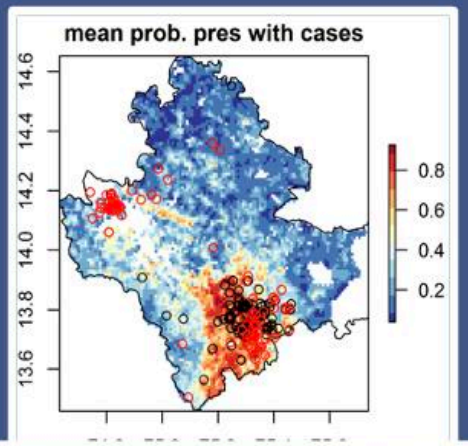
What determines human vulnerability and adaptation to disease risk?

Parasites & Vectors

RESEARCH Open Access

First evidence of transovarial transmission of Kyasanur Forest disease virus in *Haemaphysalis* and *Rhipicephalus* ticks in the wild

Predicted probability of KFD occurrence





https://indiazoorisk.ceh.ac.uk/

https://monkeyfeverrisk.ceh.ac.uk/

## Topics/priorities


Improved surveillance

Translation of evidence to policy decisions and Disease management tools

Strengthen vector and pathogen surveillance and incrimination studies

Vector-host-pathogen dynamics and interventions in ecosystems

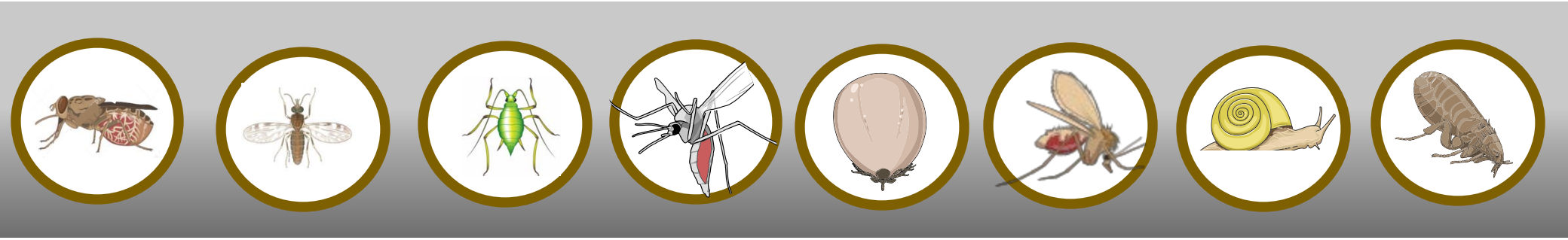
Integration of empirical research based and community based knowledge

Co-infections

**Interested in further discussion:**

Contact sburthe@ceh.ac.uk beth@ceh.ac.uk

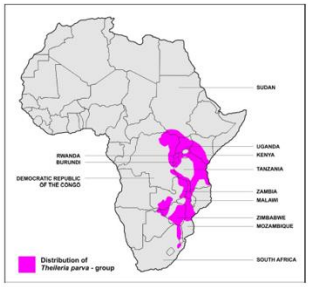
# Research intros



Tim Connelley

# Connelley Group

## 1) Immune responses to Theileria parasites



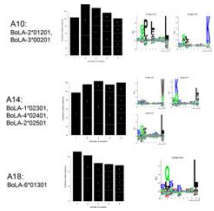

Distribution of the *Theileria parva*-group parasites in Africa

How to develop vaccines against *Theileria spp. p*arasites?

What fundamental knowledge/resources gaps (bovine) immunology need to be addressed to answer this question?

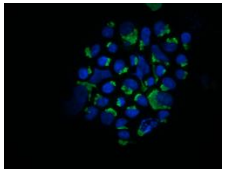
## 2) Approach

Mechanisms of T-cell mediated immunity
- *In vivo* challenge in cattle
- *In vitro* functional analyses
- Molecular work – TCR repertoire, transcriptomics



Antigen identification
- MHC defined herd
- Immunogenetics – MHC/TCR interaction
- Immunopeptidomics (collab. With Prof. N. Ternette, Uni. of Dund
- *In vitro* analyses approaches – UPL, IFNG-APC

Tick colony maintenance
- *R. appendiculatus* colony for *T. parva* stabilate generation
- *R. microplus* for genetic modification work (Oxitec)
- Development of artificial feeding systems

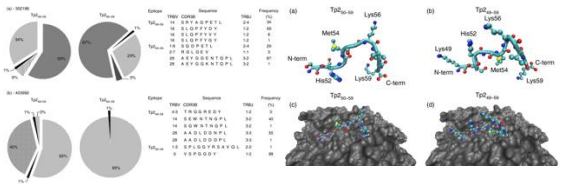


# 3) Illustrative examples

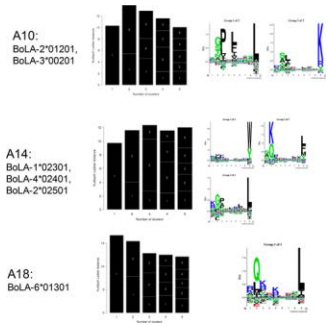
## Defining T-cell responses against *T. parva*

Immunodominance in CD8+ T-cell responses

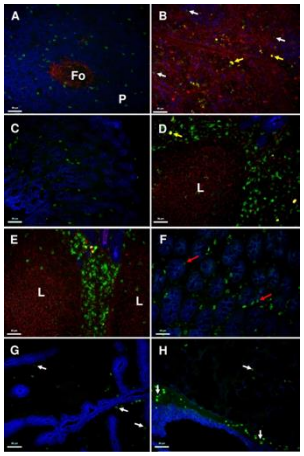
Clonal selection in CD8+ T-cell responses



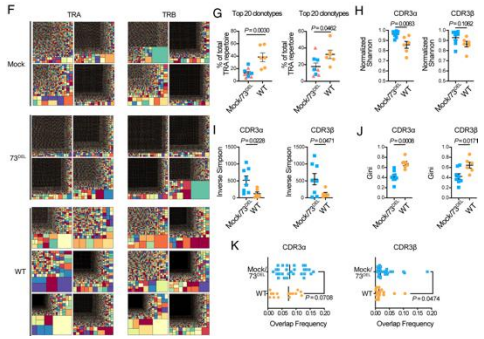
## Development and application of tools and resources for bovine immunology




MHC diversity
Nielsen *et al* 2018




NK cell characterisation
Connelley *et al* 2011/2014




TCR repertoire
Gong *et al* 2024

# 4) Topics/priorities

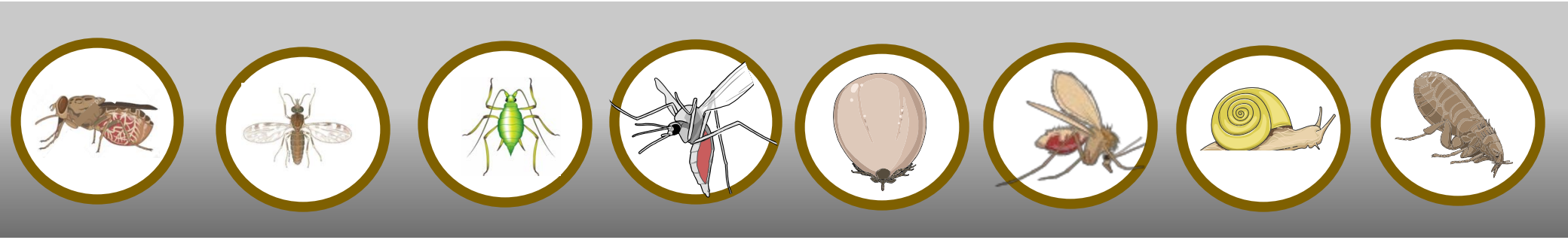
What function determines CD8+ T-cell protection?

How to rationalise the selection of candidate antigens for a T-cell inducing vaccine against a complex intra-cellular parasite?

How to develop a veterinary vaccine that would be cost effective and deployable in a LMIC environment?

**Interested in further discussion:**
Contact: timothy.connelley@ed.ac.uk

# Research intros



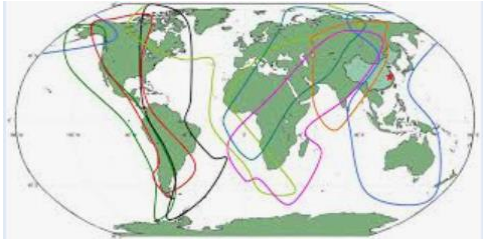
Emma Cunningham

# Cunningham group School of Biological Sciences

## Research topics

### The impact of infection and disease in animal populations

### Environmental change

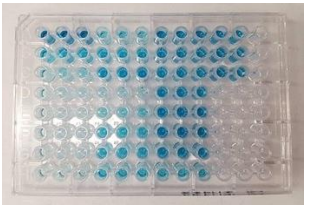


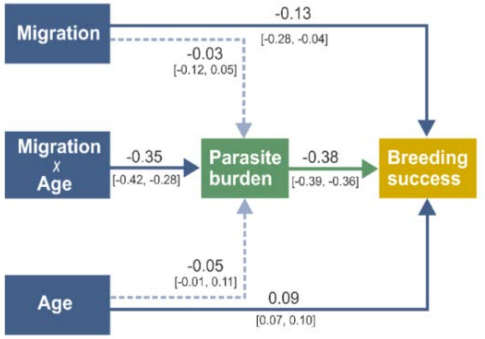
eg animal movement

### Interventions

eg treatment strategies

## Approaches



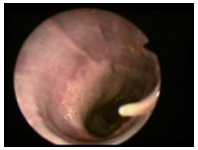


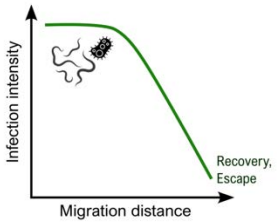

- Long term monitoring
- Disease surveillance
- Endoscopy
- Field experiments
- Ecoimmunology
- Molecular ecology
- Statistical modelling
- Input to policy

# Cunningham group School of Biological Sciences

## Recent illustrative projects

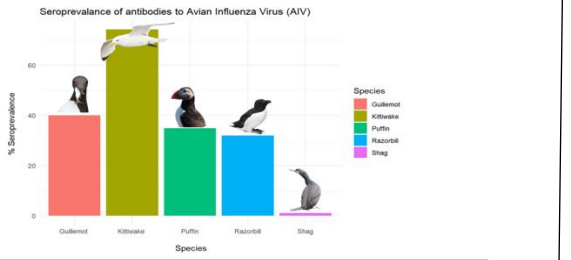
### Infection as a driver of migration






ECOFLU

iPREPARE




## Impact

Scottish Government
Riaghaltas na h-Alba

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Publication - Strategy/plan

**Scottish wild bird highly pathogenic avian influenza response plan**

Published: **11 August 2023**
From: Cabinet Secretary for Rural Affairs, Land Reform and Islands, +1 more ...
Directorate: Marine Directorate, +1 more ...
Topic: Environment and climate change, Farming and rural, Marine and fisheries
ISBN: **9781835210369**

This document sets out the approach that the Scottish Government and its agencies will take to respond to an outbreak of Highly Pathogenic Avian Influenza (HPAI) in wild birds in Scotland.

UK Research and Innovation

Department for Environment Food & Rural Affairs

Scottish Government
Riaghaltas na h-Alba
gov.scot

## Topics/priorities

Current focus:

Monitoring notifiable diseases in wild bird populations

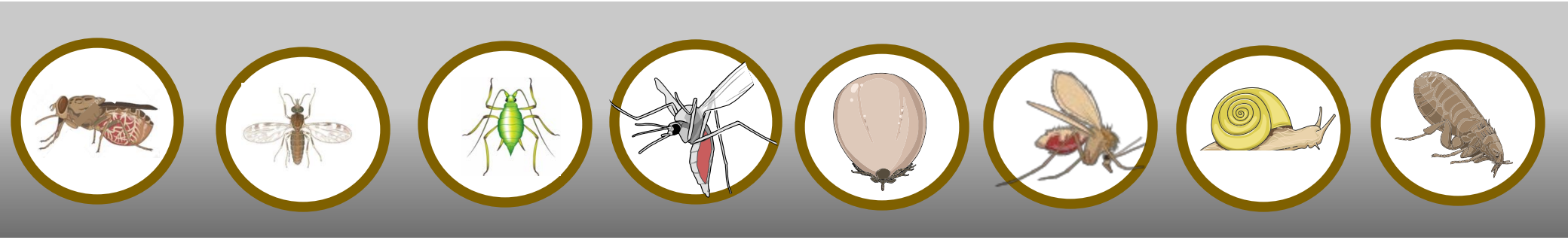
Exploring drivers of infection across multi-species assemblages

Capacity building across organisations

Linking to policy

**Interested in further discussion:**
Contact e.cunningham@ed.ac.uk

# Research intros



Katherine Dirsmith

# SEBI-Livestock:

## Supporting Evidence-Based Interventions in Livestock

SEBI LIVESTOCK
Centre for Supporting Evidence-Based Interventions in Livestock

## 1) Research topic

Livestock data is disparate and scarce, and decision makers lack reliable information on which diseases to target, and which interventions work best in a given context.

Funded by the Gates Foundation, we work with their Livestock Pillar to collate contextual and investment data to allow them to make informed decisions on resource allocation.


## 2) Approach

Collate Foundation investment data, analyzed and accessed via Tableau dashboards - Many investments from private sector for animal health product sales.

Model the economic benefit of these interventions on small-scale producers.

Livestock data needed to provide context to investments challenging

Collation of data to support modelling efforts

- Finding where national and sub-national livestock data and planning documents exist
- Systematic searching of the literature for modelling and triangulation

# 3) Example

## Livestock Health Evidence Synthesis

- Approach:
  - Update the evidence base for livestock infectious disease parameters in Africa and South Asia via systematic review
    - Newcastle disease, sheep and goat pox, **East Coast fever**, contagious caprine pleuropneumonia, **Lumpy skin disease**, **Rift Valley fever**, peste des petits ruminants, contagious bovine pleuropneumonia, brucellosis, foot and mouth disease, **common ectoparasites and endoparasites**
- Impacts: Disease parameters from updated evidence base used to inform disease economic impact models


**What do we know about livestock diseases in Ethiopia? A birds-eye view of recent evidence**

**Isla MacVicar, Louise Donnison, Vanessa Meadu, Karen Smyth and Andrew Peters**

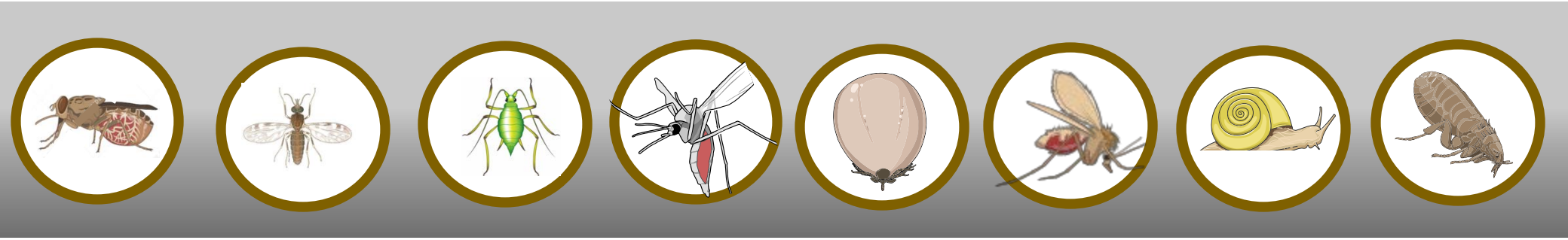
The systematic evidence map allows users to quickly take stock of evidence on livestock disease prevalence and mortality. The map reveals the distribution and quantity of available evidence, and highlights areas for further investment and research.

# 4) Topics/Priorities

- Collaborate with campus and livestock health communities to ensure evidence synthesis projects directly benefit practitioners, stakeholders, and other end users

**Contact details for more information:**
Director: Karen Smyth: karen.smyth@ed.ac.uk
General enquiries: sebi@ed.ac.uk
Website: https://sebi-livestock.org/
Presenters:
Johanna Wong: johanna.t.wong@ed.ac.uk
Katie Dirsmith: katherine.dirsmith@ed.ac.uk

# Research intros



Seb Hennige

# Changing Oceans Group, GeoSciences

## 1) Research topic

### Corals in a changing ocean

- Controls of cross species susceptibility (many vectors)
- Impact of environmental change/events

## 2) Approach

### Summary

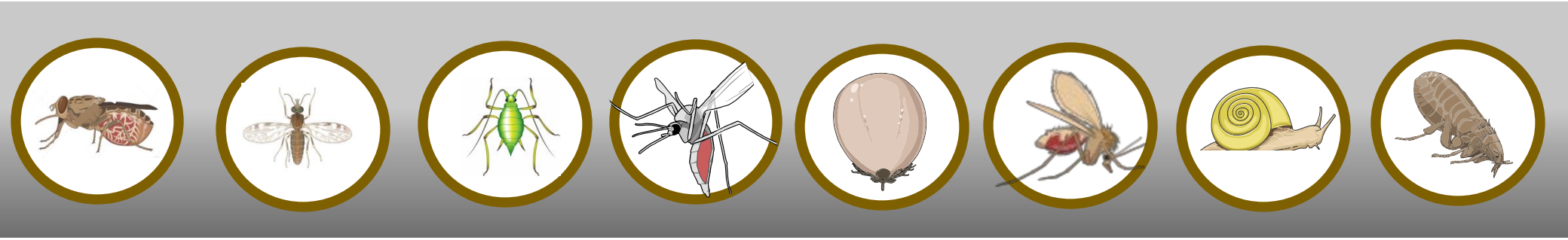
- Multiple stressor facilities for corals.
- Field sites

# 3) Illustrative examples

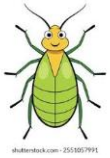
- Will ‘winners’ of bleaching be at risk of increased susceptibility?
- Are there any diseases in deep sea corals? Evidence of different self/non self recognition to tropical corals (non siblings will fuse)

**Interested in further discussion:**
Contact s.hennige@ed.ac.uk

# Research intros



Gail Jackson



# Agroecology at Edinburgh

Gail Jackson. School of GeoSciences

THE UNIVERSITY of EDINBURGH

## 1) Biological control (and IPM) of crop pests

***How can vectors of crop viruses be sustainably controlled*?**

**Aphids are the main insect vectors of plant viral diseases e.g. Barley Yellow Dwarf Viruses**

- **Aphid vectors increasingly resistant to insecticide**
- **Environmental and economic imperatives**
- **Parasitoid wasps predate aphids in huge numbers**
- **Can wasps be sustained by floral nectar?**

Barley Yellow Dwarf Virus

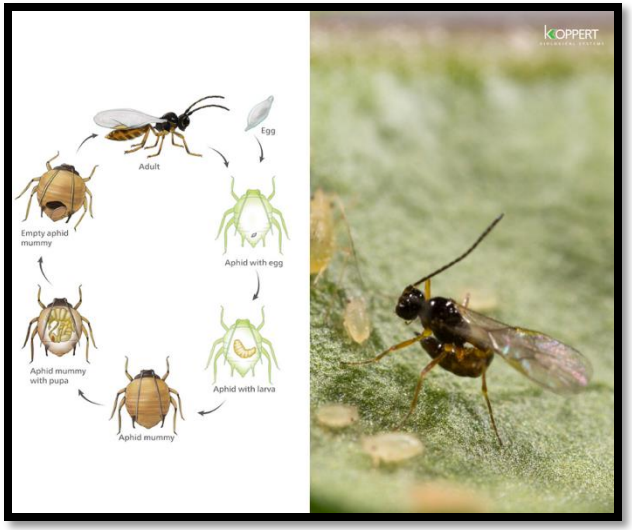
*Sitobion avenae*
The English grain aphid

## 2) Approach

**Augmentation of parasitoid populations, in**

- **Glasshouse/insectary trials**
- **Field trials**

*Aphidius ervi*
Parasitoid wasp




**Keywords**
Aphids, parasitoid wasps, floral nectar, BYDV. Natural enemies

# 3) Illustrative examples

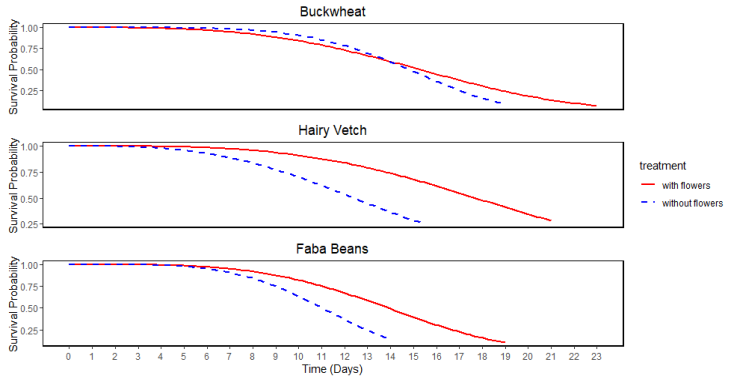



**Figure 1.** Wasp longevity, with and without floral nectar
Red line – with flowers. Blue line – without flowers.
Wasps live longer with access to floral nectar

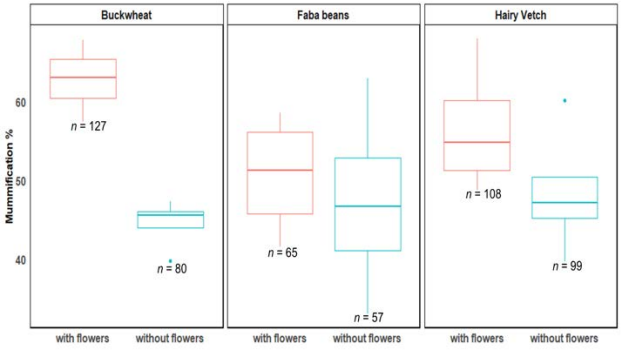



**Figure 2.** Wasp parasitisation efficiency, with and without floral nectar. Red – with flowers. Blue – without flowers
More aphid mummies produced by wasps with access to floral nectar

# 4) Topics/priorities

Field trial at Boghall Farm
Intercrop: beans and spring barley
Augmentative release of wasps
Monitoring:
- Aphid and wasp numbers
- Wasp mummification efficiency
- Barley Yellow Dwarf Virus

## Sugar beet - Virus Yellows

Vector is the aphid: *Myzus persicae*

Neonicotinoid insecticide used to control the aphid vector

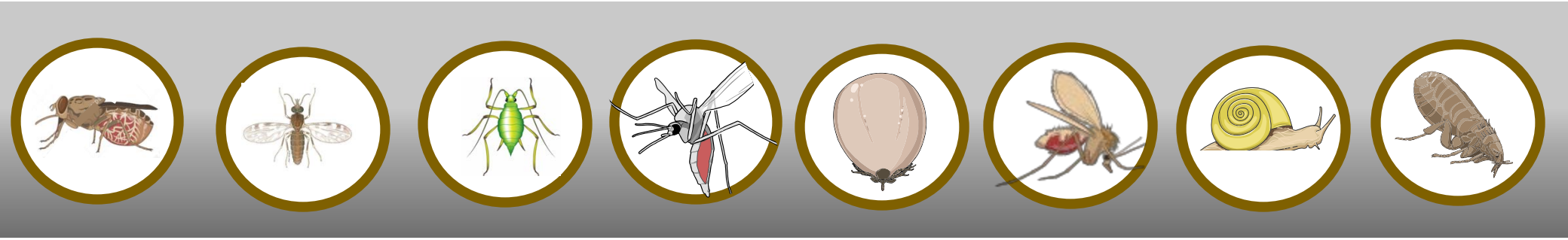
Now totally banned!

Use wasps to control aphids

Sustain wasps with floral nectar

**Interested in further discussion:**
Contact G.Jackson@ed.ac.uk

# Research intros



Rowland Kao

# Rowland Kao Group
# R(D)SVS, Roslin & SoPA

## 1) Infectious disease population dynamics

**How do combinations of land use and environmental change intersect with EIDs to create emergent system behaviour?**

- Changes in wildlife diversity
- Using sequence data to identify ecological relationships
- Exploiting large datasets
- Working with data gaps and data biases

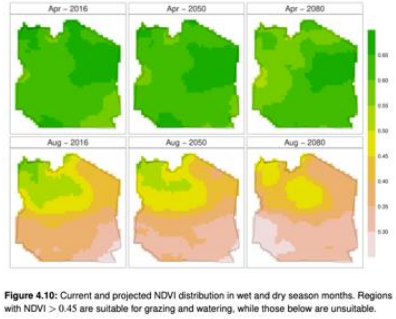
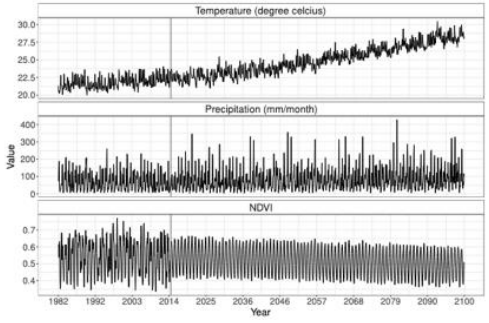



**Figure 4.10:** Current and projected NDVI distribution in wet and dry season months. Regions with NDVI > 0.45 are suitable for grazing and watering, while those below are unsuitable.




Changes in temperature and precipitation influence both mosquitos and livestock

## 2) Approach – Data-driven models and conceptual/abstract models

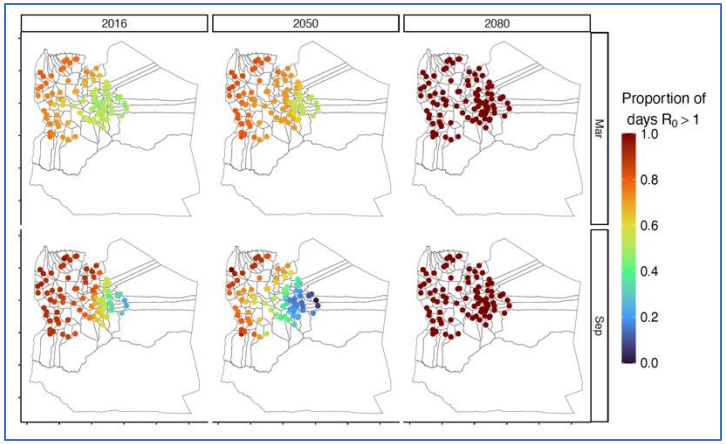
Complexity Science/Networks
Simulation models
Statistics & Machine Learning

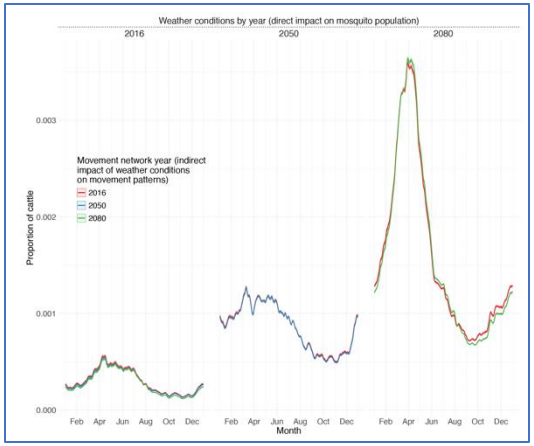
Phylodynamics & Evolution

- Bluetongue Virus
- **Rift Valley Fever**

# 3) Illustrative examples

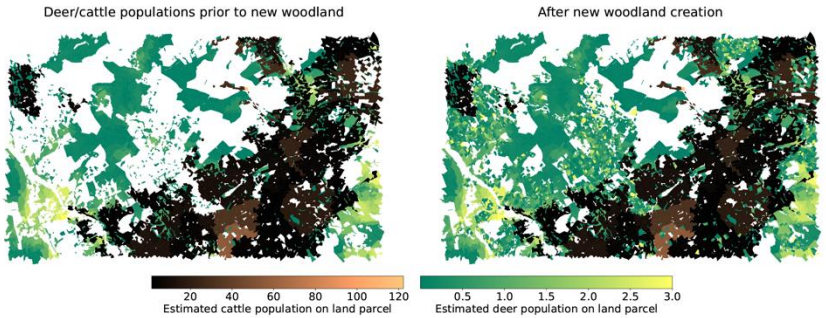
## Project 1 Emergence of RVF problems in northern Tanzania




Changes due to grazing/watering patterns plus vector survival

## Project 2 Env. mgmt scheme uptakes and impact on EID




Largest impact in SW Scotland is on deer/cattle intersections > 35% increase (indicator of possible driver of EIDs)

# 4) Topics/priorities

Impact of behaviour/non-economic considerations

Better approaches to estimating changes in wildlife abundance and ranging behaviour

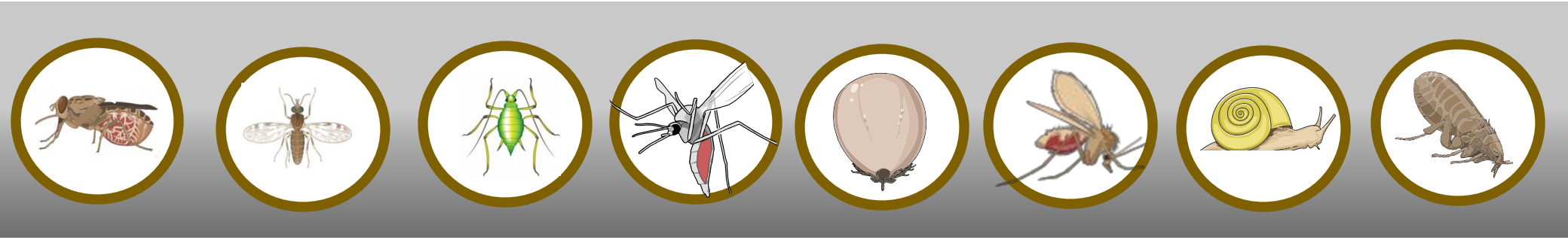
Game-based approaches to understanding intersection between impact of land use on EID and vice versa

Acknowledgements:
RVF - Tijani Sulaimon (PhD student)
ELM - Chris Banks (Roslin Core Scientist)

**Interested in further discussion:**

Contact: Rowland.kao@ed.ac.uk

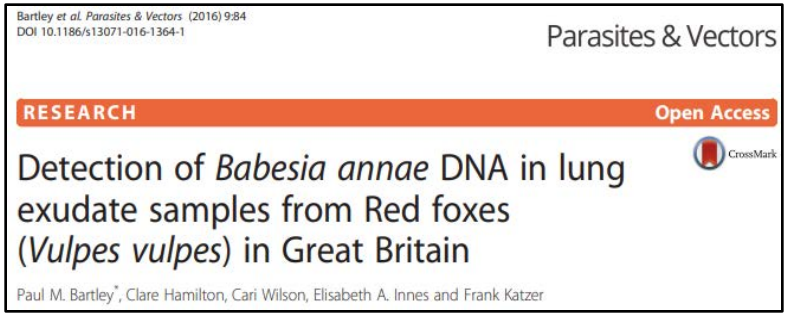
# Research intros



Frank Katzer

# Detection of *Babesia* in wildlife and livestock in Scotland

Moredun Research Institute



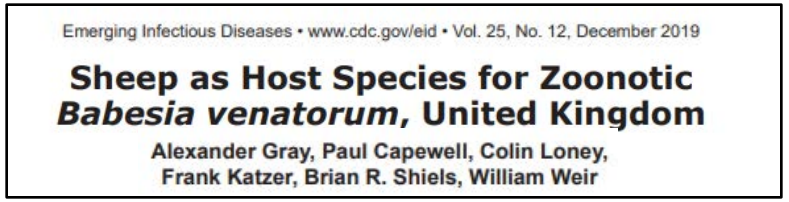
Bartley *et al. Parasites & Vectors* (2016) 9:84
DOI 10.1186/s13071-016-1364-1

Parasites & Vectors

RESEARCH Open Access

Detection of *Babesia annae* DNA in lung exudate samples from Red foxes (*Vulpes vulpes*) in Great Britain

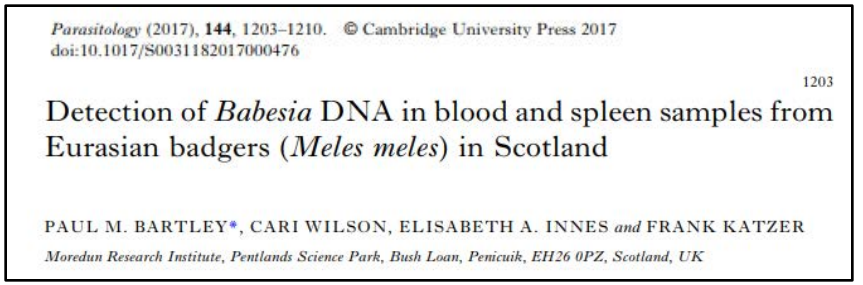
Paul M. Bartley*, Clare Hamilton, Cari Wilson, Elisabeth A. Innes and Frank Katzer



Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 25, No. 12, December 2019

**Sheep as Host Species for Zoonotic *Babesia venatorum*, United Kingdom**

**Alexander Gray, Paul Capewell, Colin Loney, Frank Katzer, Brian R. Shiels, William Weir**



*Parasitology* (2017), **144**, 1203–1210. © Cambridge University Press 2017
doi:10.1017/S0031182017000476

1203

Detection of *Babesia* DNA in blood and spleen samples from Eurasian badgers (*Meles meles*) in Scotland

PAUL M. BARTLEY*, CARI WILSON, ELISABETH A. INNES *and* FRANK KATZER

*Moredun Research Institute, Pentlands Science Park, Bush Loan, Penicuik, EH26 0PZ, Scotland, UK*

Current Research in Parasitology & Vector-Borne Diseases 1 (2021) 100019

Contents lists available at ScienceDirect

Current Research in Parasitology & Vector-Borne Diseases

journal homepage: www.editorialmanager.com/crpvbd/default.aspx

ELSEVIER

Wild deer in the United Kingdom are a potential reservoir for the livestock parasite *Babesia divergens*

Alexander Gray [a], Paul Capewell [b], Ruth Zadoks [a,b,c,1], Mark A. Taggart [d], Andrew S. French [d,2], Frank Katzer [c], Brian R. Shiels [b], William Weir [a,*]

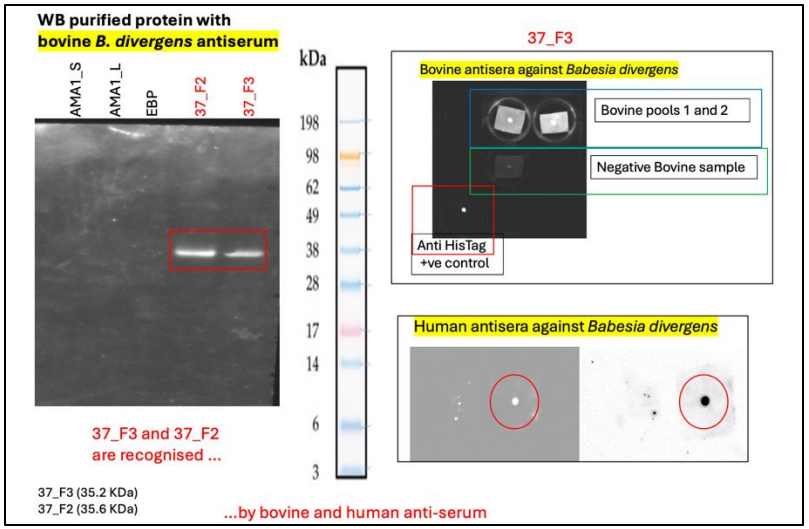
University of Glasgow

# Recombinant antigen ELISA development for *Babesia divergens*, *B. venatorum* & *B. microti*

Moredun Research Institute

## Progress made so far:

- We generated 10 recombinant *Babesia* proteins for 8 potential candidate antigens for ELISA development.
- For ***B. divergens*,** one antigen was selected.
- It is immunogenic and cross reacts with *B. venatorum* positive human serum.
- For ***B. microti,*** 3 proteins were expressed and purified; they are immunogenic.
- We started to develop the *B. divergens* ELISA




Moredun Research Institute

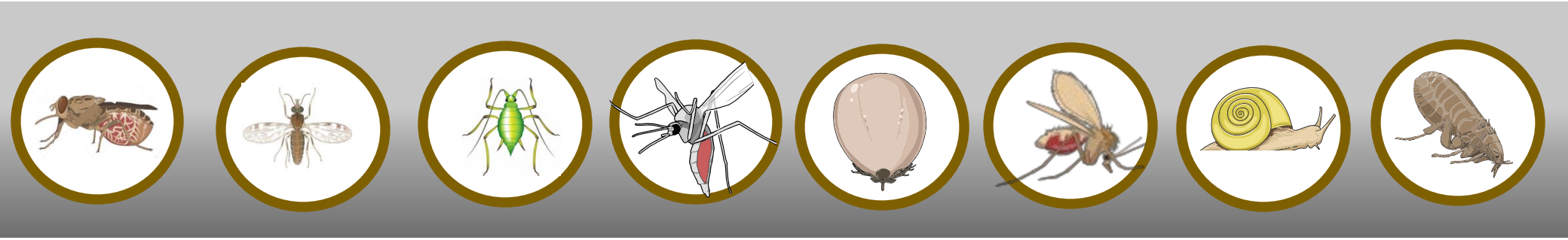
NHS SCOTLAND

Funding a healthier future

MEDICAL RESEARCH SCOTLAND

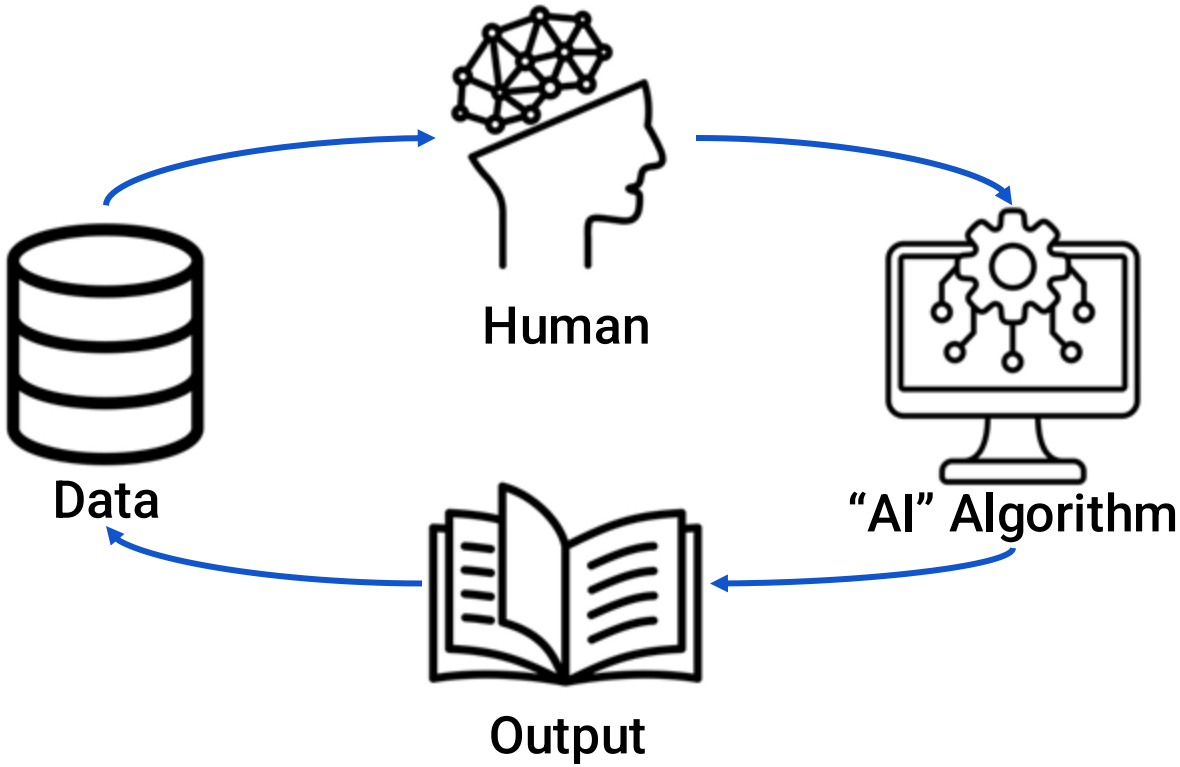
University of Glasgow

# Research intros

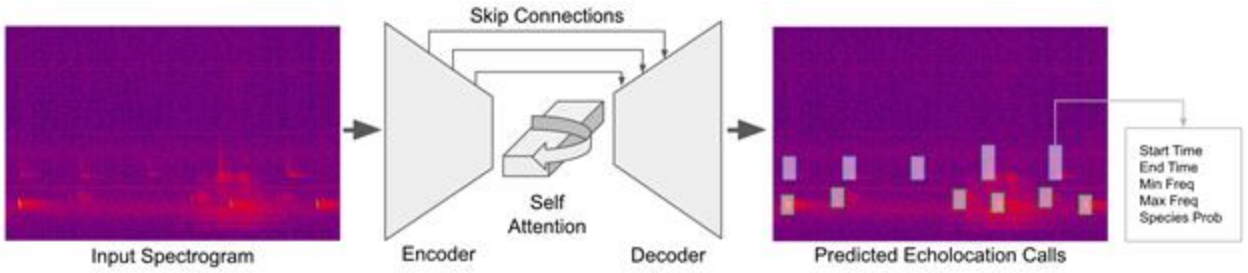


Oisin Mac Aodha

# Oisin Mac Aodha - School of Informatics

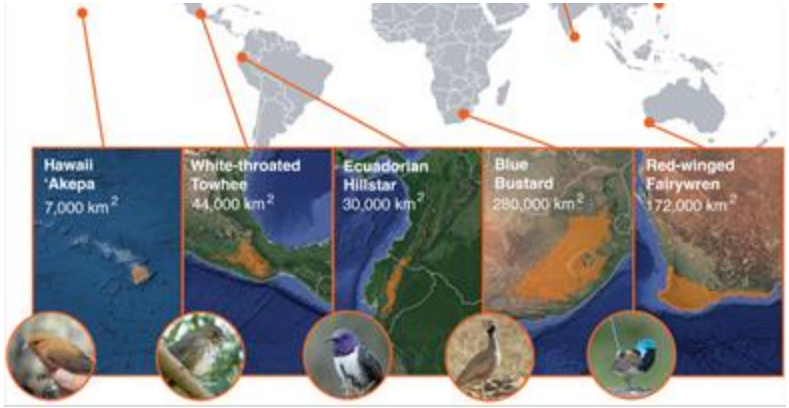


## Bioacoustic Monitoring



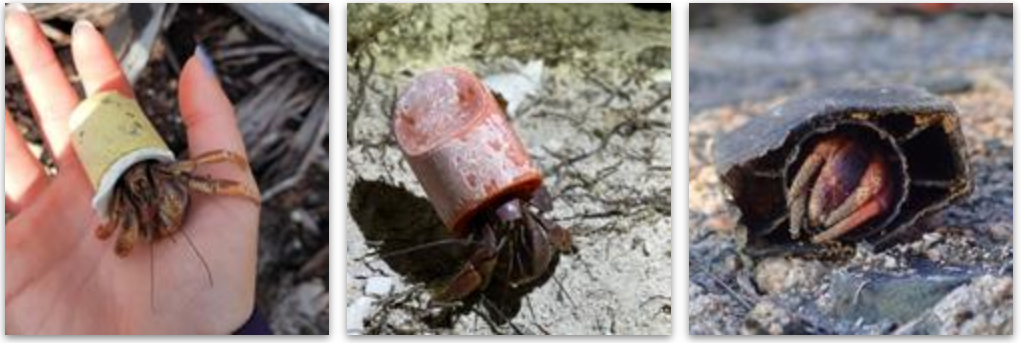

*Detecting bats from audio recordings.*

## Species Range Estimation




*Working with iNaturalist to generate species range maps from noisy crowd sourced data.*

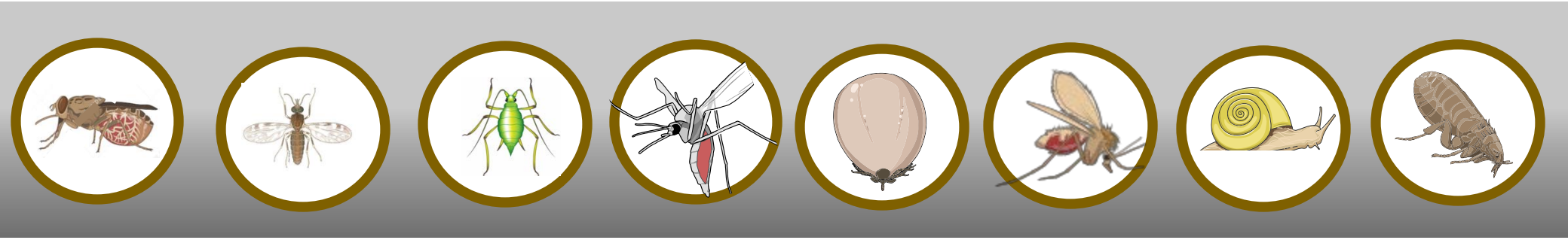
## Fine-Grained Computer Vision



*"A hermit crab using plastic waste as its shell"*

Contact oisin.macaodha@ed.ac.uk

# Research intros

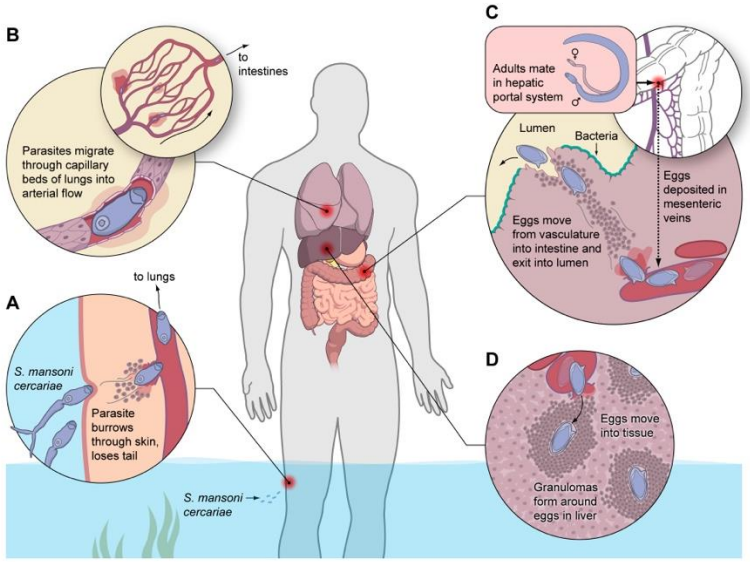


Andrew MacDonald

# MacDonald Group (IIIR)

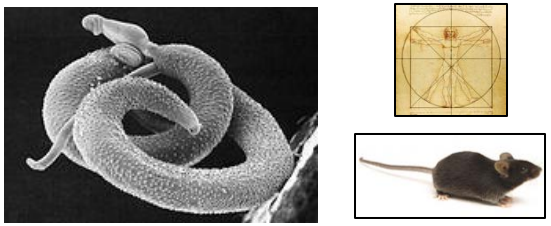
## 1) Research topic: Immunobiology of schistosomiasis

**How is the (mammalian) host response against *S. mansoni* initiated, directed, maintained and regulated?**

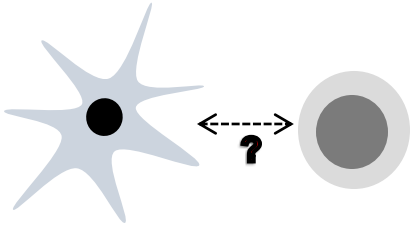



- **Keywords**: immunoparasitology; helminths; host response; immunopathology; chronicity; cellular immunology; mucosal immunology

## 2) Approach: use of *in vivo* (mouse) models and human samples to discover novel immune targets to enable innovative future therapies



Murine and human *S. mansoni* infection samples




- **Keywords**: ; *in vivo* tissues/environments; murine infection; human samples; microbiome; immunometabolism; dendritic cells; macrophages; CD4 T cells

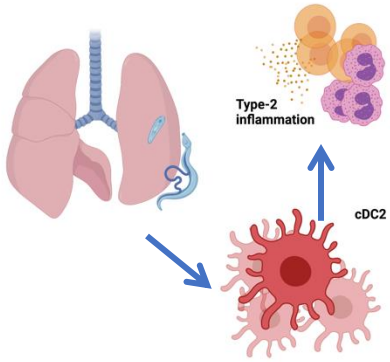
# 3) Illustrative examples

## Project 1: what are the defining features of the pulmonary response to *S. mansoni*?

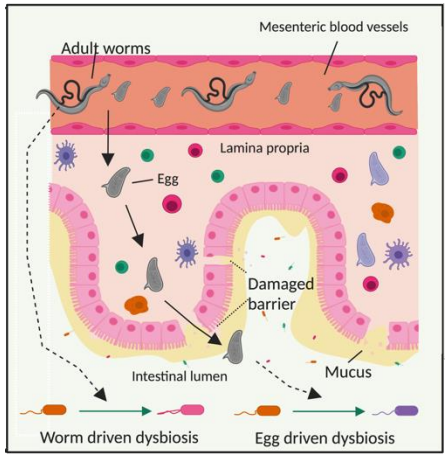
**Pulmonary inflammation promoted by type-2 dendritic cells is a feature of human and murine schistosomiasis**

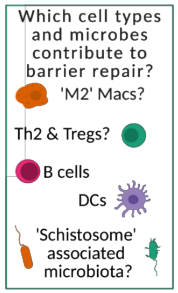
E. L. Houlder[1,2], A. H. Costain[1,2], I. Nambuya[1,3], S. L. Brown[1], J. P. R. Koopman[2], M. C. C. Langenberg[2], J. J. Janse[2], M. A. Hoogerwerf[2], A. J. L. Ridley[1], J. E. Forde-Thomas[4], S. A. P. Colombo[1], B. M. F. Winkel[2], A. A. Galdon[1], K. F. Hoffmann[4], P. C. Cook[1,5], M. Roestenberg[2], H. Mpairwe[3] & A. S. MacDonald[1]

Nature Communications | (2023)14:1863




## Project 2: what are the defining features of the intestinal response to *S. mansoni*?



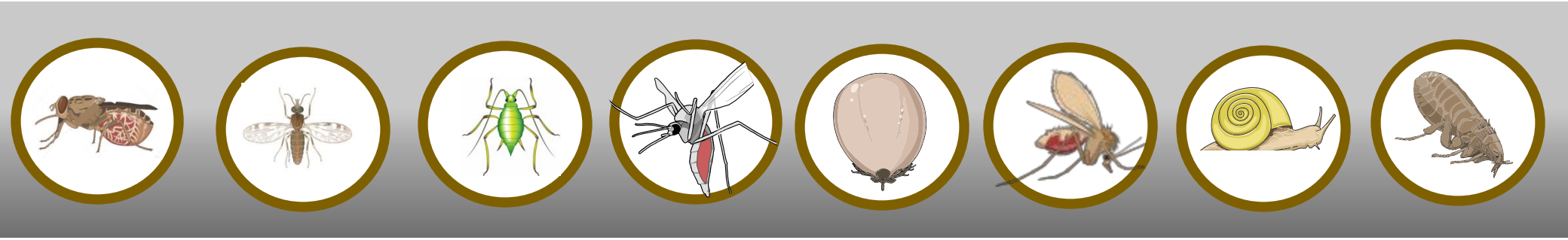




# 4) Topics/priorities

- **Cellular Immunology**
  - *Innate and type-2 (DCs, Macs, CD4⁺ T cells)*
  - *Chronicity/regulation*
  - *Immunometabolism*
- **Environmental (tissue) control of inflammation and immunopathology**
  - *Lung, gut, liver, skin: inflammation/damage vs regulation/repair*
  - *S. mansoni impact on other diseases, locally and systemically (including coinfection)*
- **Mucosal Immunology**
  - *S. mansoni vs allergic type-2*
  - *Mucosal/barrier cross-talk (lung, gut, uterus, skin)*
  - *Microbiome*

**Interested in further discussion:**
Contact *andrew.macdonald@ed.ac.uk*

# Research intros



Keith Matthews

# Matthews Group

THE UNIVERSITY of EDINBURGH
School of Biological Sciences
College of Science and Engineering

## 1) Research topic –

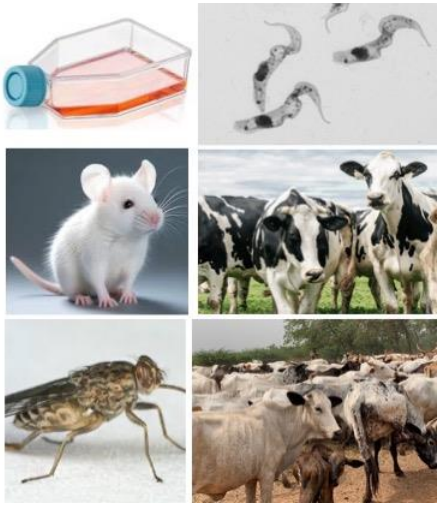
### African trypanosome transmission biology

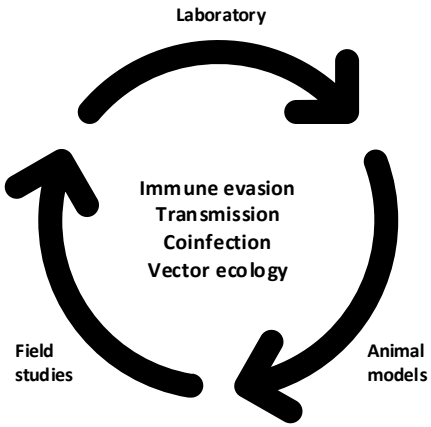

What are the controls of parasite development and how can they adapt to
coinfection or altered vector prevalence?

## 2) Approach –

Laboratory molecular analyses coupled with

- parasite biology,
- genomic analysis
- host infection dynamics (mouse &cow)
- Tsetse transmission biology

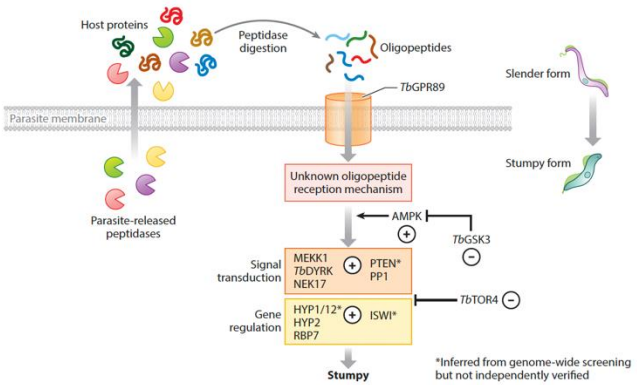




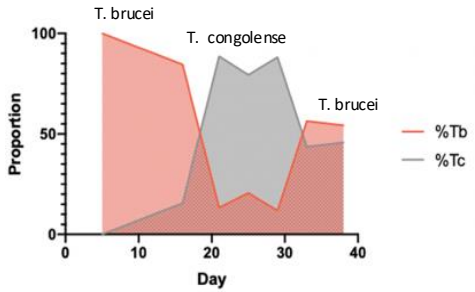
# 3) Illustrative examples

*Molecular control of development*

Mony et al *Nature* 2014
Rojas et al *Cell* 2019
Briggs et al *Nature Comm* 2022

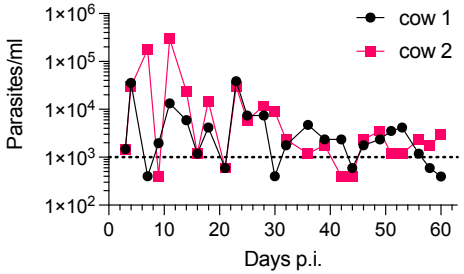



*Parasite coinfection dynamics*




Silvester et al *Nature Microbiology* 2017
Venter et al, unpublished

*Natural host (cattle) infection dynamics*




Larcombe et al
*PNAS* 2023
Larcombe et al
submitted

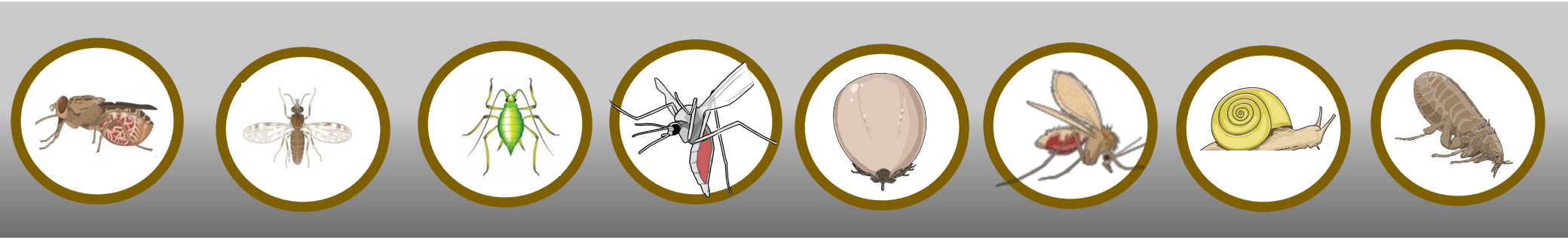
Key collaborator: Prof Liam Morrison

# 4) Priorities in this intersection

- How trypanosomes prepare for transmission in molecular terms
- How trypanosome transmission biology changes in response to coinfection with other trypanosomes
- How trypanosomes adapt to vector changes (through vector control, climate change) by evolving alternative transmission modes

**Interested in further discussion:**
Contact : keith.matthews@ed.ac.uk

# Research intros

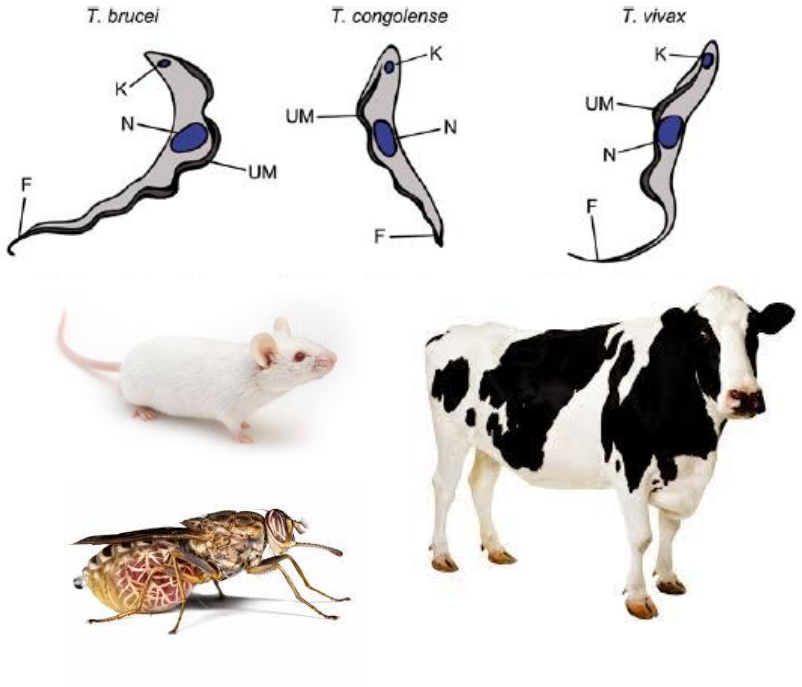


Liam Morrison

# Liam Morrison Roslin Institute

## 1) Research topic – infection biology of livestock trypanosomes

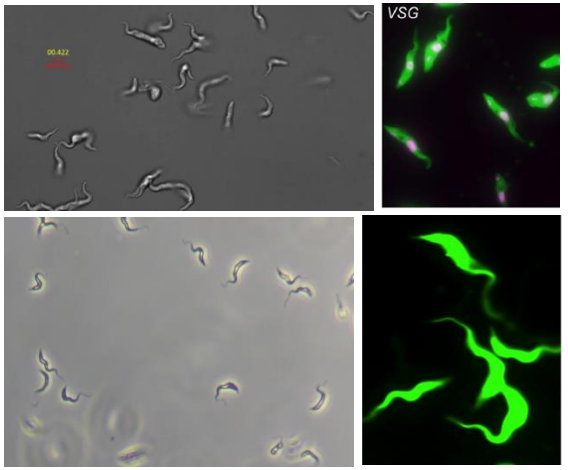
***Overall aim – work with clinically relevant hosts and pathogens to gain insights into biology and potential interventions***




## 2) Approach:

- **Develop capabilities to work with *T. congolense* and *T. vivax*, the bovine infection model, and the tsetse fly vector**
- **Apply these capabilities to key questions**

## Summary




- *Drug development & resistance*
- *Vaccine development*

- *Metabolism*
- *Immunity & immunosuppression*
- *Antigenic variation*
- *Differentiation*

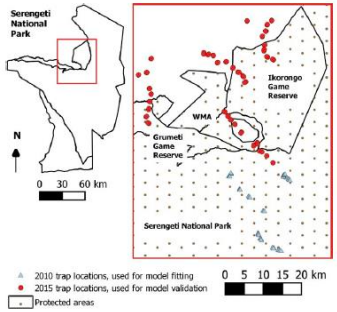
## 3) Illustrative example

**Integration of laboratory approaches to understand treatment failure and drug resistance in animal trypanosomosis**

- Interdisciplinary study assessing trypanosome prevalence, vector populations, and identifying causes of treatment failure in Tanzania

*Key outputs:*

- Identification of mechanism of resistance to isometamidium
- Farmer-led control of human disease through insecticide application on cattle
- First robust assessment of relative roles of incorrect drug use, drug resistance and counterfeit drugs in AAT epidemiology
- Engagement with FAO, WOAH, drafting of FAO guidelines on drug use, National strategy for Tanzania
- International AAT meeting in Tanzania




Symposium on African Livestock Trypanosomiasis, Tanzania (SALT-Tz)

## 4) Topics/priorities

***Identification of strategies to optimize drug use and sustainability***

- First new drug for >60 years

***Key infection biology questions:***

***Trypanosome-mediated immunosuppression***

- mechanism & extent in cow
- how does it impact on vaccination?

***How do key phenotypes vary across trypanosome species***

- antigenic variation

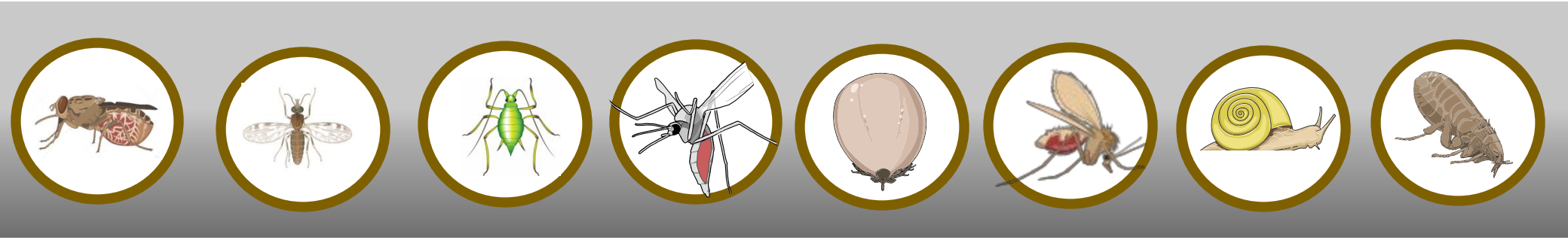
***Where do trypanosomes go in the cow during infection?***

- Tissue adaptation & transmission

***Coinfections & impacts upon other pathogens, and control strategies (drugs, vaccines)***

**Interested in further discussion:**
Contact **Liam.Morrison@roslin.ed.ac.uk**

# Research intros



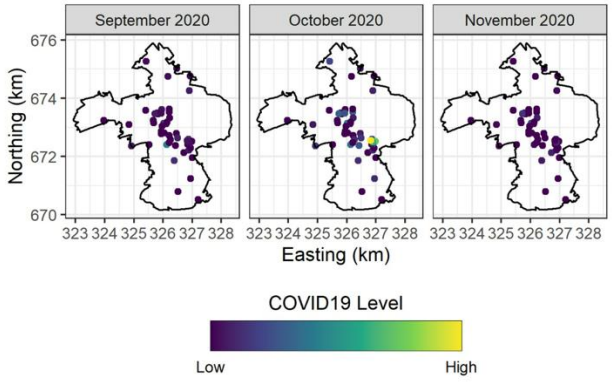
Glenna Nightingale
(presented by Ewelina)

# Spatiotemporal Epidemiology – COVID-19, HiSS

## **Research topic** – Spatiotemporal models in epidemiology

**Laxton (University of Glasgow),** Nightingale (University of Edinburgh), Lindgren (University of Edinburgh), Sivakumaran (NHS Lothian), Othieno(NHS Lothian)
Funding by the Edinburgh Futures Institute

## **Overall aim:** To demonstrate the application of three new R Numbers by using the hyperparameters of Log Gaussian Cox Process models in an epidemiological context




Keywords: Marked point patterns, Three new R numbers

## **Approach** – Log Gaussian Cox Process models.

- Hierarchical Bayesian Modelling.
- Log Gaussian Cox Processes (LGCP) are point process models which constitute special case of latent Gaussian models (the class of models that can be fitted with INLA).
- INLA and the SPDE approach allow a computationally efficient model to be fitted in continuous space.
- Spatial and temporal correlation structures are represented by a Gaussian Random Field (GRF) with a Matérn covariance structure.
- User-friendly software package R-inlabru.

## Summary

**R spatial**—an indication of the distance over which cases are correlated with each other and serve as an estimation of the extent of the spread of the virus within halls of residence (a spatial R number)
**R spatiotemporal**- indicates the correlation in the spatial distribution of COVID-19 positivity as the timeline progresses. The positive estimate of this index indicates that as the months progress from September towards December the COVID19 positivity will be correlated to the previous month.
**R scaling**—defines the strength and direction of the interaction between density of university halls of residence and residence COVID-19 levels.

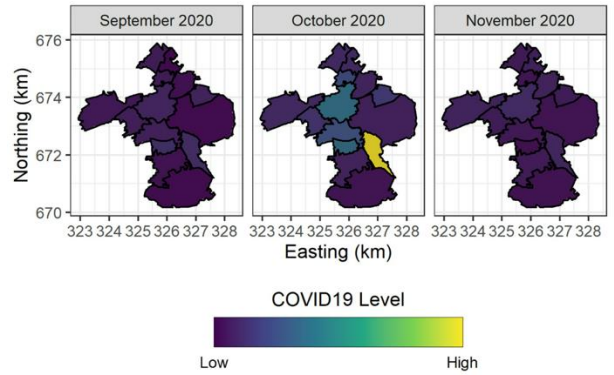
Keywords : **R spatial, R Spatiotemporal, R scaling**

## 3) Illustrative examples

**Project 1 summary question / finding**

Are there any spatial patterns of COVID-19 positivity in the halls of Edinburgh University and the surrounding communities?

**R spatial:** 0.19[0.13,0.27]: The range in connectivity in COVID-19 levels between university halls of residence in Edinburgh as an average of 0.19km, with 95% CI between 0.13km and 0.27km.

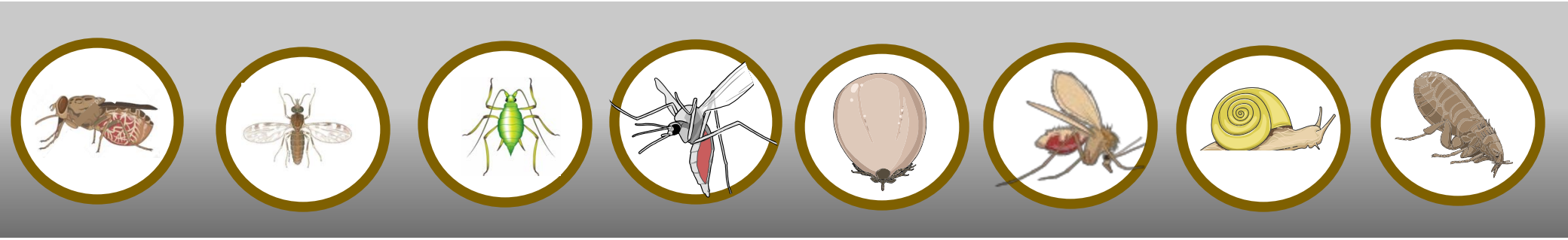



## 4) Topics/priorities

Extending the concept of the use of the proposed R numbers to other VBDs and collaborating with other colleagues at the UoE.

**Interested in further discussion:**
Contact Glenna.Nightingale@ed.ac.uk

# Research intros



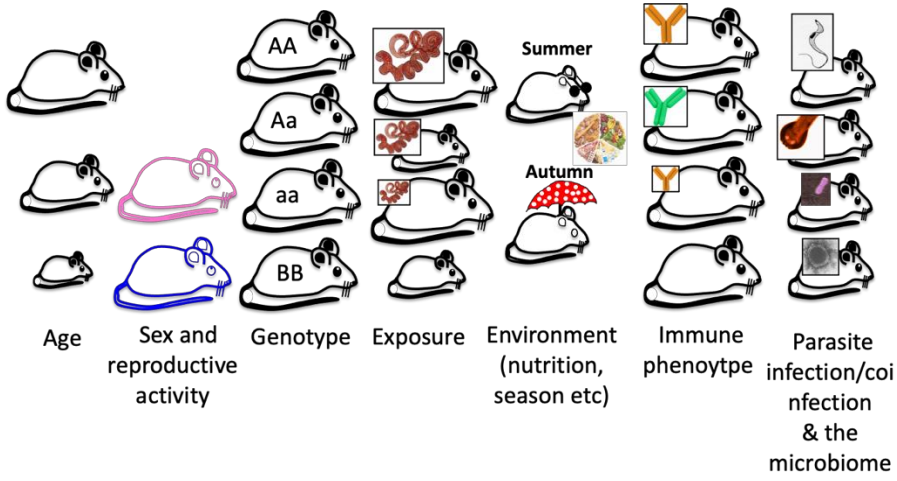
Amy Pedersen

# Pedersen Group

THE UNIVERSITY of EDINBURGH
*School of Biological Sciences*, College of Science and Engineering

## 1) Research topic – Disease ecology

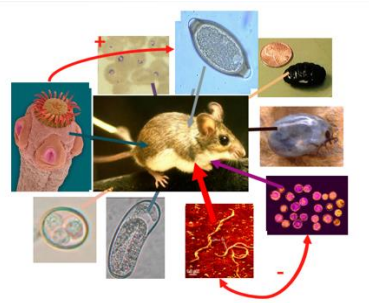
*Aim to understand the impact of parasites in natural populations*

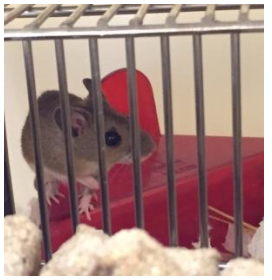



**Can an ecological approach provide a framework for understanding infection, immunity and transmission?**

## 2) Approach –

Wild-lab mouse model investigating a diverse suite of parasites, pathogens and vectors– mostly in UK woodland/habitats

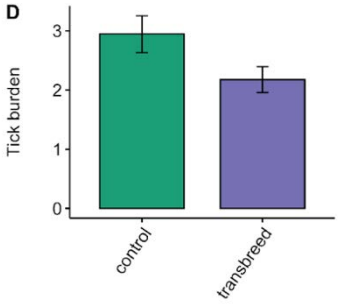


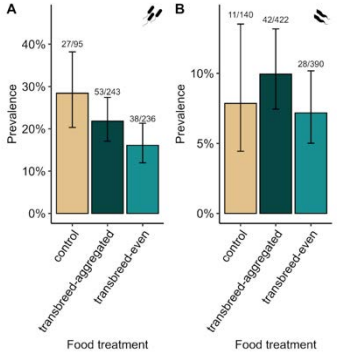


- Ecology
- Parasitology
- Viral/bacterial/protozoa
- Ticks/fleas
- Vaccination
- Microbiome
- Immunology
- Ageing
- Nutrition

# 3) Illustrative examples

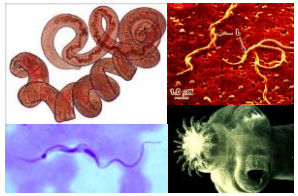
The impact of resource supplementation on ticks and VBPs in wild wood mice (Agata Delnicka)

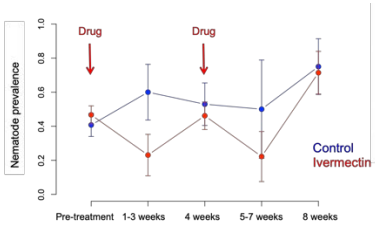



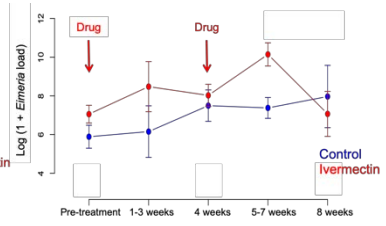




| Pathogen | Bilston Wood 2019 (n=222) | Bilston Wood 2020 (n=211) | Penicuik 2019 (n=266) | Penicuik 2020 (n=270) | Penicuik 2021 (n=37) |
|---|---|---|---|---|---|
| *B. burgdorferi s.l.* (OspA) | 0 (0 - 1.7) | 0 (0 - 1.8) | 0 (0 - 1.4) | 0 (0 - 1.4) | 0 (0 - 9.4) |
| *B. burgdorferi s.l.* (FlaB) | 0 (0 - 1.7) | 0 (0 - 1.8) | 0 (0 - 1.4) | 0 (0 - 1.4) | 0 (0 - 9.4) |
| *N. mikurensis* | 0 (0 - 1.7) | 0 (0 - 1.8) | 0 (0 - 1.4) | 0 (0 - 1.4) | 0 (0 - 9.4) |
| *B. miyamotoi* | 1.4 (0.5 - 3.9) | 0.5 (0.1 - 2.6) | 0.8 (0.2 - 2.7) | 0.7 (0.2 - 2.7) | 2.7 (0.5 - 13.8) |
| *B. microti* | 2.3 (1 - 5.2) | 0.5 (0.1 - 2.6) | 0.4 (0.1 - 2.1) | 0.4 (0.1 - 2.1) | 0 (0 - 9.4) |
| *A. phagocytophilum* | 4.1 (2.1 - 7.5) | 4.7 (2.6 - 8.5) | 3.8 (2.1 - 6.8) | 5.2 (3.1 - 8.5) | 54.1 (38.4 - 69) |
| *Bartonella* | 19.4 (4.7 - 25.1) | 32.2 (26.3 - 38.8) | 17.7 (13.6 - 22.7) | 20.7 (16.3 - 26) | 16.2 (7.7 - 31.1) |
| *S. ixodetis* | 0 (0 - 1.7) | 0 (0 - 1.8) | 0.4 (0.1 - 2.1) | 0.7 (0.2 - 2.7) | 0 (0 - 9.4) |
| *R. helvetica* | 0.5 (0.1 - 2.5) | 0 (0 - 1.8) | 0 (0 - 1.4) | 0 (0 - 1.4) | 0 (0 - 9.4) |
| *Babesia* Clade X | 0 (0 - 1.7) | 0 (0 - 1.8) | 0 (0 - 1.4) | 0 (0 - 1.4) | 0 (0 - 9.4) |

Does coinfection impact host health, parasite transmission, and the impact of control strategies (i.e. drug treatment and vaccination)





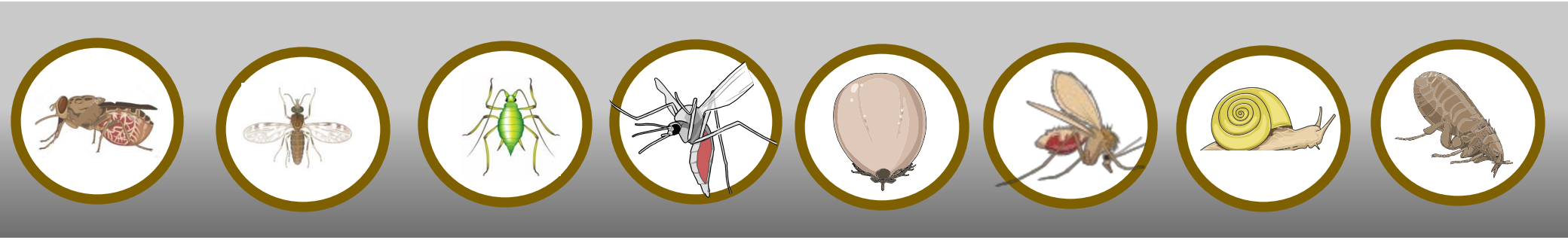




# 4) Topics/priorities in this intersection

- The role of wild rodents in Scotland (UK/Europe) in facilitating tick populations and zoonotic pathogen maintenance and transmission
- The impact of climate and environmental change on wildlife and their parasite/pathogens
- Using the lab-to-wild mouse model for infection, coinfection, and vector transmission studies

**Interested in further discussion:**
Contact Amy Pedersen: amy.pedersen@ed.ac.uk

# Research intros



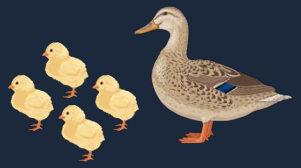
Sarah Reece

# Reece Group Institute of Ecology & Evolution, Schl. Biological Sciences

## 1) What makes a successful parasite?

Explain the strategies that parasites have evolved to maximise survival in the host and transmission between hosts (i.e. fitness)

Reproductive strategies

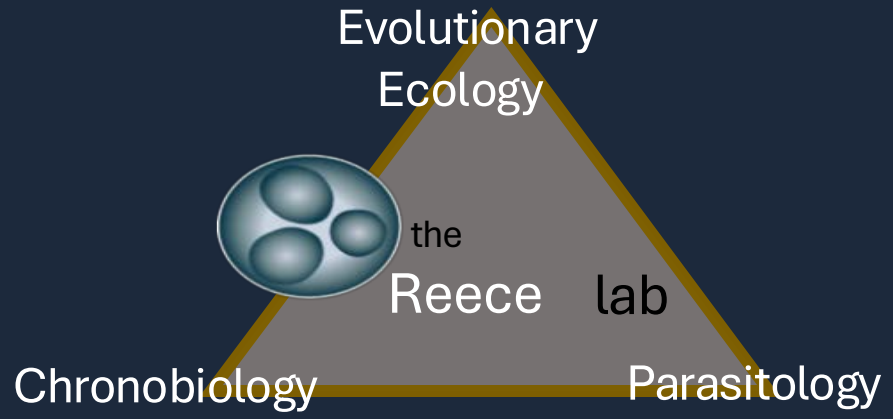


Cooperation & conflict

Telling the time

- More 'sophisticated' than expected
- Great model and inform disease control

## 2) Approach

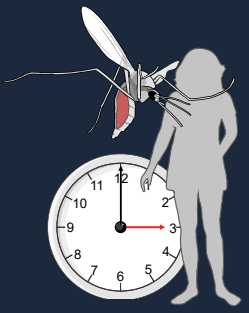



*Plasmodium chabaudi*

*Anopheles stephensi*

- Phenotypes, traits, of host, parasite, vector
- Lab + field (Ghana) experiments & theory

## 3) Example



Transmission depends on time of day
- rhythms of **all** parties matter
- parasites control their rhythms

- Vector control (bed nets) + light@night are altering transmission rhythms

Daily rhythms applicable to other VBDs
e.g. who is at risk?

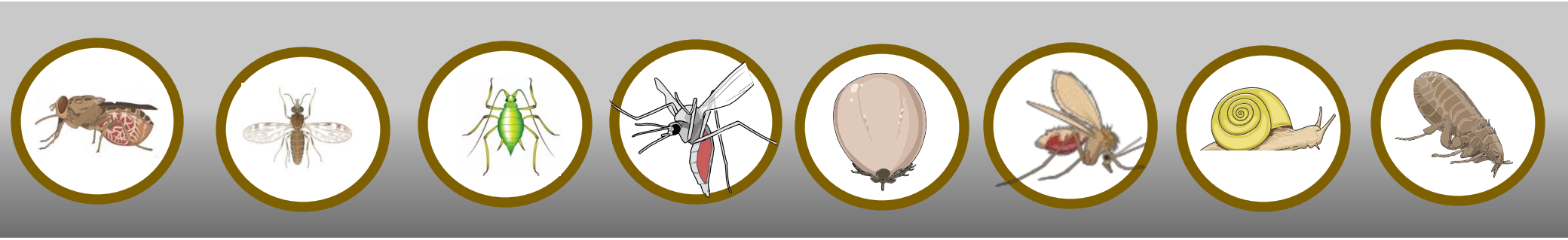
Prior…PLOS Paths 2018; Schneider…Proc Roy Soc 2018; Westwood…Nat Ecol Evol 2019; O'Donnell…Proc Roy Soc 2020; Subhudi…Nat Comms 2020; Prior…Cell Host Mic 2020; Holland…Phil Trans 2024

## 4) Topics/ priorities

- Environmental sensing and adaptive (plastic) responses
- Roles of daily rhythms in infections (within host/vector survival, transmission)
- Parasite evolution in response to **vector control** and other selection pressures from:
  - Vector genotypes
  - Vector behaviour
  - Drug treatment
  - Environmental change

Sarah.Reece@ed.ac.uk, TheReeceLab.com

# Research intros



Mara Rocchi

# Moredun vector and VBDs projects

## 1) Landscape of fear (with UoG)

Do humans shape their own exposure to ticks through a "landscape of fear" ?

## 2) Louping ill vaccine development

LIV and TBDs on the rise: vaccine development and validation of a challenge model

## 3) Diagnosis of zoonotic *Babesiae*

Zoonotic Babesia in the UK: development of diagnostic serological assay for One Health Surveillance

## 4) Sheep scab control

Diagnostic tests and management protocol in place: now we need a vaccine!

## 5) Poultry red mite vaccine

Reverse vaccinology approaches for a recombinant vaccine to protect laying hens against PRM infestation

## 6) Livestock TBDs surveillance

SG-funded livestock TBDs testing: LIV, TBF, Babesia

## 7) Knowledge exchange

Ticks and TBDs stakeholder workshop

## Approaches – landscape of fear

10m blanket drag transects

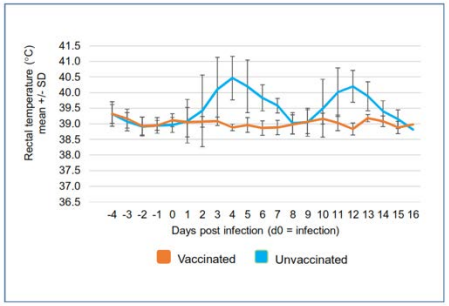
STRAVA for path usage (high-low)
Statistical analysis (

Tick density and deer dung piles, birds, rodents and vegetation; pathogens in collected ticks
?Deer space-use and tick density increase with distance from high-usage trails? Does TBDs risk increase?

## Approaches – LIV vaccine

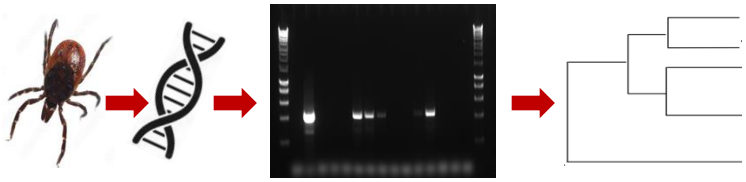
High sheep and grouse mortality
Vaccine discontinued in 2017
New LIV vaccine (VLPs)
Challenge model re-established
Vaccine tested *in vivo* (CL3)
No clinical signs or neuropath
Limited market authorisation in progress

Temperature response in infected sheep



# Approaches – zoonotic *Babesiae*

- Zoonotic *Babesiae* found in Scottish livestock and wildlife (microti/venatorum/divergens)
- Lack of test for serosurveillance (human/animal)
- Recombinant antigen ELISA in development
- Antigens are immunogenic and react with human sera
- 18s sequences indicates zoonotic potential similar to European *Babesiae*

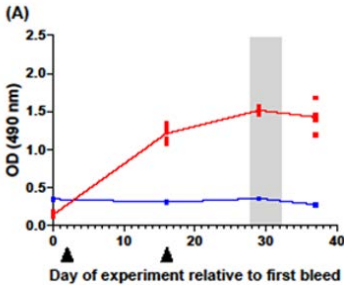


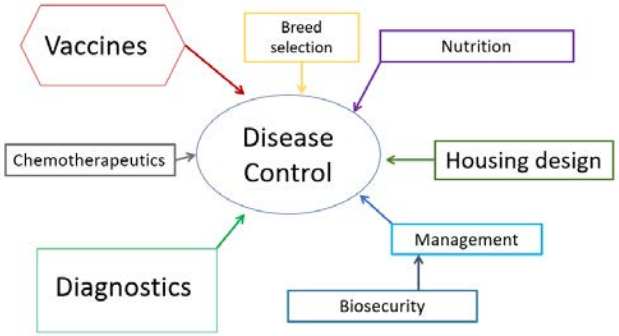
# Approaches - sheep scab vaccine

- rELISA developed
- Moving to POC
- Management & treatment optimised
- Protectiev immunity demonstarted
- Recombinant vaccine currently in field trials

# Approaches – PRM vaccine

Vaccine antigens selected from feeding-induced transcripts




There are no "stand alone" interventions for PRM control

# Approaches – TBD surveillance

Diagnostic test development and livestock surveillance
Serological (LIV) and molecular (LIV, TBF, Babesia)
Link to zoonotic potential (TBF ecotypes by phylogenetic)

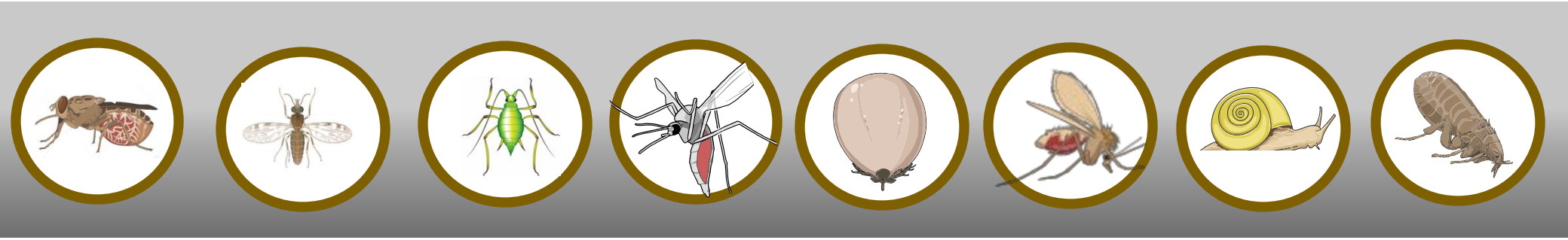
› Pathogens. 2023 Jan 30;12(2):216. doi: 10.3390/pathogens12020216.

Presence of *Anaplasma phagocytophilum* Ecotype I in UK Ruminants and Associated Zoonotic Risk

Laura Bianchessi [1], Mara Silvia Rocchi [2], Madeleine Maley [2], Kayleigh Allen [2], Keith Ballingall [2], Lauretta Turin [1]

**Interested in further discussion:**
Contact mara.rocchi@Moredun.ac.uk

# Research intros



Ewelina Rydzewska-Fazekas

# Spatiotemporal Epidemiology - Dengue Group

## School of Health in Social Science

**Topic:** The effect of climate variables and deprivation on the incidence of Dengue in Brazil

**Research questions:**

1) What is the quantitative effect of climate variables such as rainfall and temperature on morbidity from Dengue in Brazil?
2) What are the spatiotemporal trends of the incidence of Dengue fever in Brazil in the presence of key explanatory variables?

Glenna Nightingale, Ewelina Rydzewska-Fazekas, Claudio Maierovitch P. Henriques, Noely Fabiana Oliveira de Moura, Stephen Villejo, Andrew Seaton, Emanuele Giorgi, Luciana Brondi

**Methods**

-Brazilian information system for notifiable diseases (SINAN), which is part of the National Surveillance System for communicable diseases

-monthly counts of new Dengue cases and incidence (per population) for 5,665 municipalities across Brazil in 2012-2020

-Dengue surveillance data accompanied by clinical information, laboratory tests, and sociodemographic markers

-deprivation: Brazilian Deprivation Index (IBP)

-climate: temperature (Celsius) and precipitation levels (mm)

-models with both spatial and spatiotemporal components

## 3) Key results

- higher levels of Dengue cases were evident in the months of January to April
- higher numbers of cases also occurred for regions in the higher deprivation quintiles
- there was a lower number of cases recorded in Quintile 5 compared to Quintile 4
- there was a noticeable trend for temperature where a distinct peak in Dengue incidence was observed between 28-33 degrees Celsius, with the highest peaks observed for Quintile 4
- there was also a clear relationship with precipitation, with the highest peaks in number of cases observed in Quintile 4

## 4) Future priorities

Future work will include

(i) analysis of other variables such as urbanisation, state level, and race

(ii) considering additional data for 2021-2023

(iii) investigating whether there was a "pandemic effect“ on the number of Dengue cases

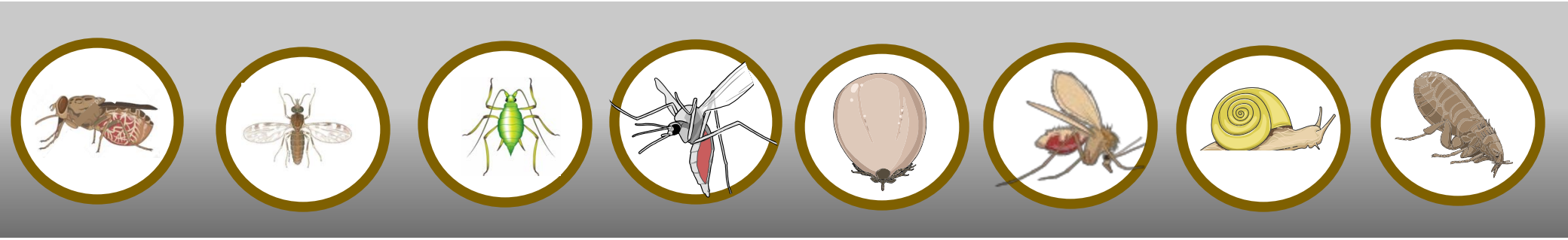
(iv) creating an R Shiny app for researchers and public health officials to explore the project output

(v) liaising with policymakers to co-design interventions to mitigate high Dengue incidence in Brazil

Glenna Nightingale, Ewelina Rydzewska-Fazekas, Claudio Maierovitch P. Henriques, Noely Fabiana Oliveira de Moura, Stephen Villejo, Andrew Seaton, Emanuele Giorgi, Luciana Brondi

**Interested in further discussion:**
Contact Glenna.Nightingale@ed.ac.uk

# Research intros



Andrew Schurer

# Andrew Schurer

Chancellors fellow
School of GeoSciences
University of Edinburgh


Research topic

- Interested in causes of past climate variability
- Use modelling and statistical approaches to understand past variability to improve our projections of future climate change and its impacts.
- Extreme events, event attribution.
- Societal impacts


a.schurer@ed.ac.uk


## Relevant **projects** include:

**"Attributable impacts from extreme weather events".** A NERC-funded pushing the frontiers grant

- A novel reanalysis-based system which translates recent and historical **extreme weather events** into warmer or cooler ('**counter-factual**') climates and examine how their meteorological consequences and impacts are changed.
- Events include: heavy rainfall, windstorms, heatwaves and droughts, **impacts** on **society** will be investigated

**National Hub on Net Zero, Health and Extreme Heat**

- Assess and realise the co-benefits of the net zero transition and the reduction in **health risks** associated with **extreme heat** for **vulnerable communities**
- Analyses **climate extremes** particularly co-occuring **compound events** (e.g. heat, air pollution and wild fires), and working with the rest of the hub to understand how they will affect vulnerable communities in both indoors and outdoors settings.

- Within Global change institute, School of Geosciences research:
- Climate change and air pollution, climate variability and extremes, climate impacts on air quality and on human health.
- Modelling and measurements (low cost sensors)

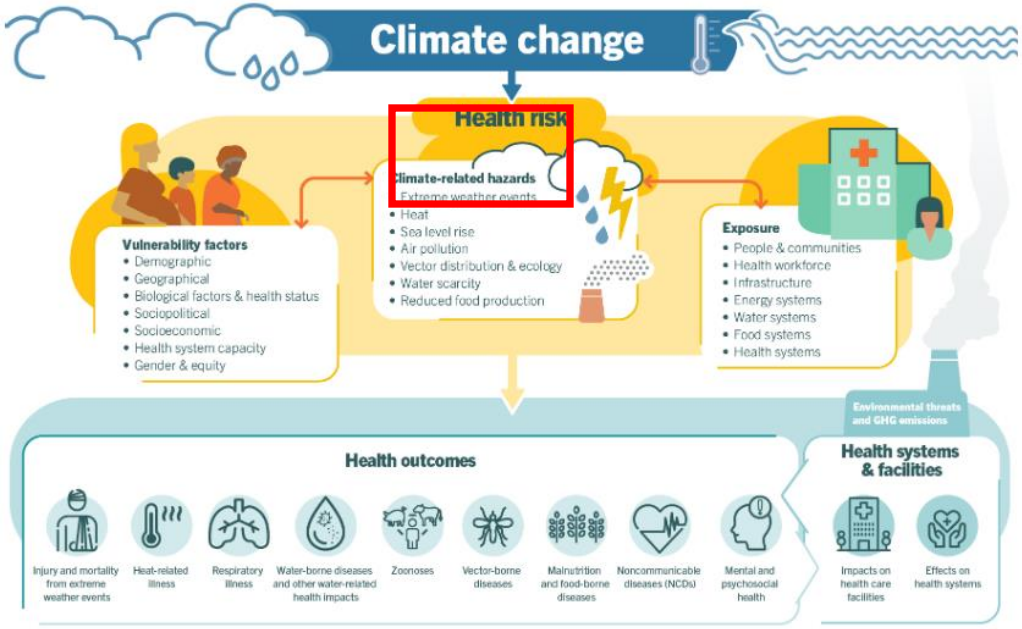
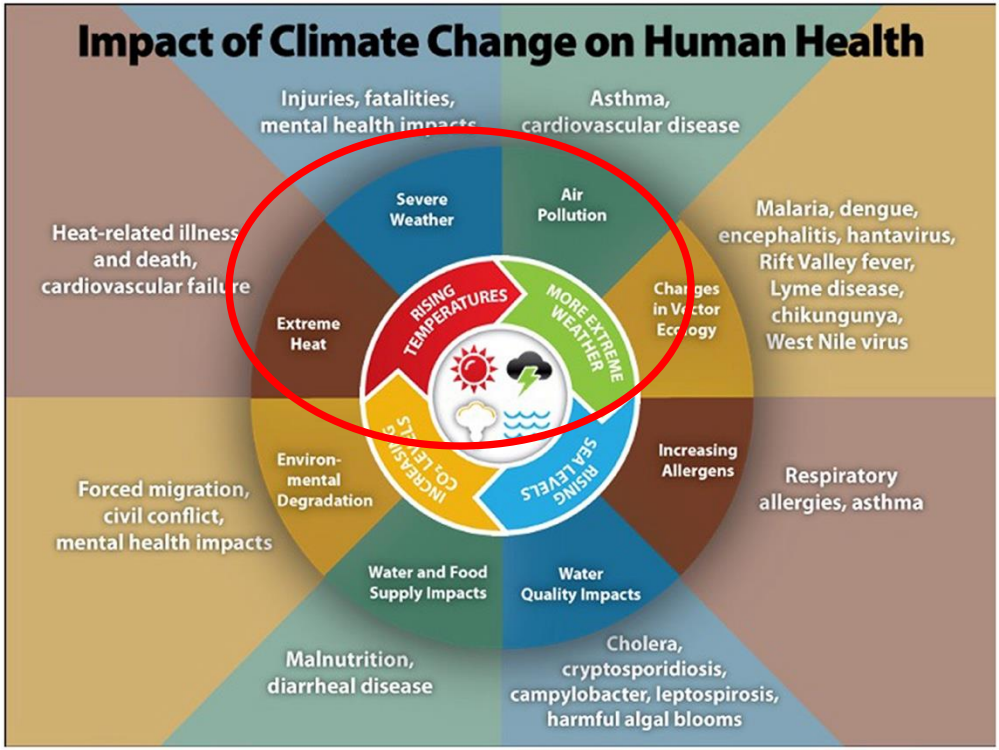


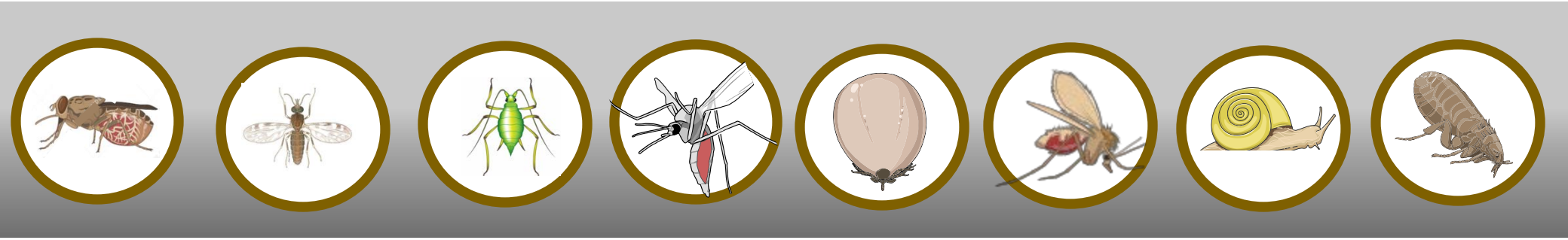

*Figure: An overview of climate-sensitive health risks, their exposure pathways and vulnerability factors. Climate change impacts health both directly and indirectly, and is strongly mediated by environmental, social and public health determinants.*

https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health




Campbell et al. (2023) https://doi.org/10.3389/fpubh.2022.1086858

# Research intros

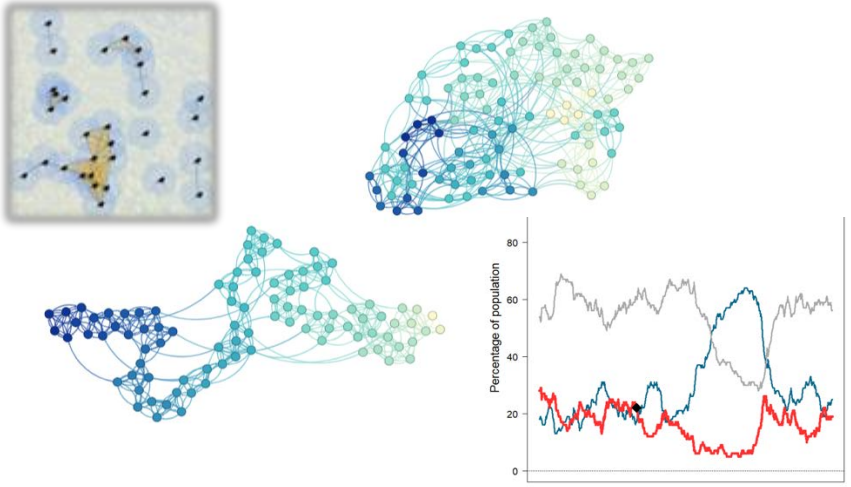


Matt Silk

# Silk Group IEE/SBS/CSE

## 1) Research topic – *Behavioural disease ecology*

*How do social structure and dynamics contribute to infectious disease spread and maintenance?*

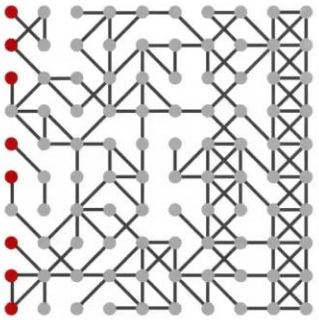



*How do pathogens shape social ecology and evolution?*

## 2) Approach – *Networks*

- Data collection and analysis in wildlife population

- Long-term studies

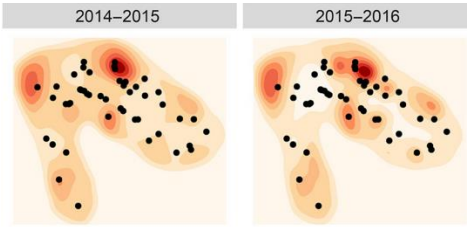


- Computational modelling

# 3) Illustrative examples

**Modelling disease dynamics from spatial capture-recapture data**

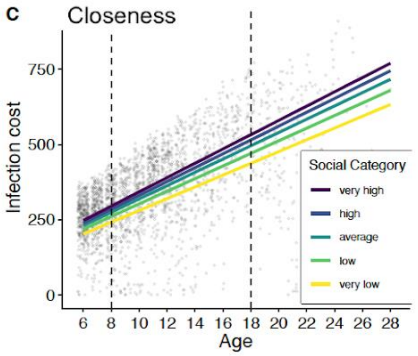
New model linking movement, disease and demography in wildlife




Spatial epidemiology, links between disease, behaviour and survival

**Social ageing and infectious disease costs**

Reduced social centrality can protect old individuals more from infectious disease




# 4) Topics/priorities

How does host behaviour (social/spatial) affect pathogen maintenance?

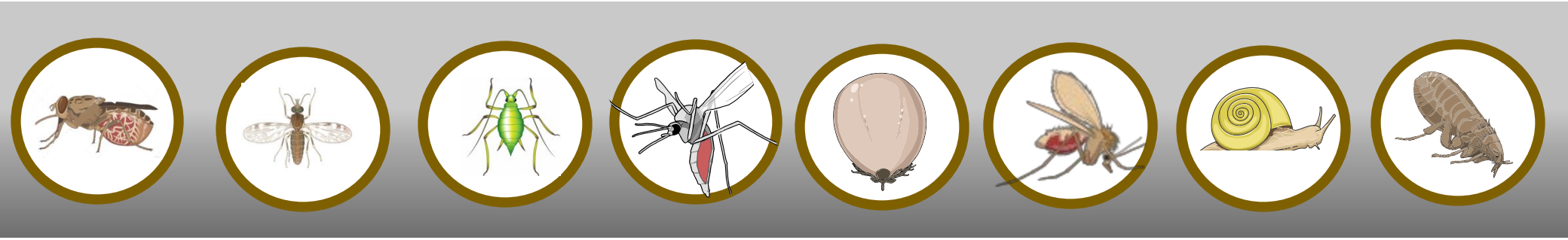
How might behavioural responses to vectors/vector-borne pathogens shape social structure and dynamics?

How do social/spatial behaviour mediate anthropogenic impacts on wildlife disease?

**Interested in further discussion:**

Contact: Matthew.Silk@ed.ac.uk

# Research intros



Emily Simmonds

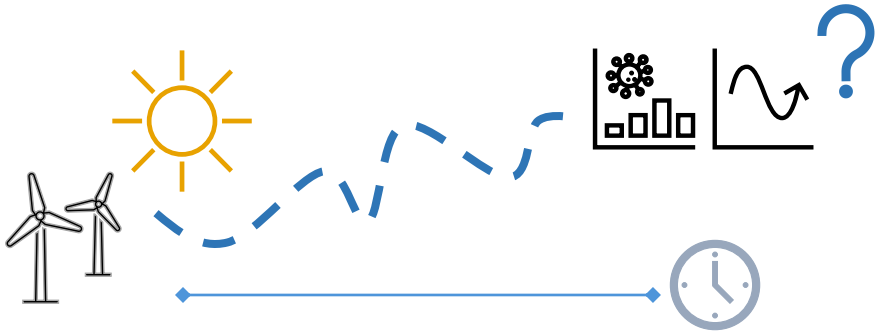
# EcoForecast Group

## Institute of Ecology and Evolution

## Lead: Emily G. Simmonds

**1) Research topic –**

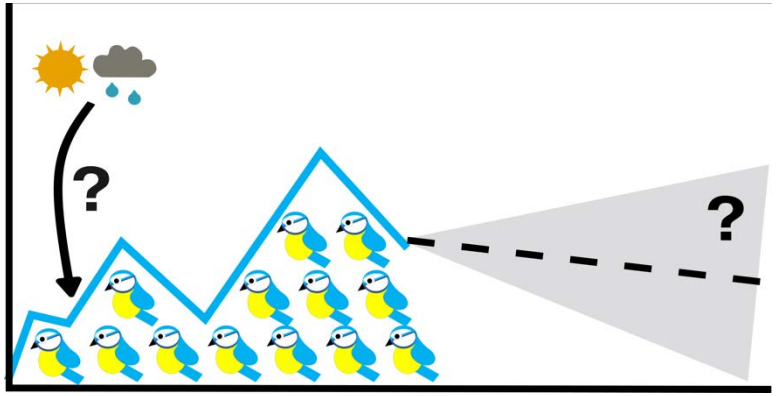
Ecological forecasting



**How do disease dynamics impact population responses to climate change and vice versa?**

**2) Approach –**

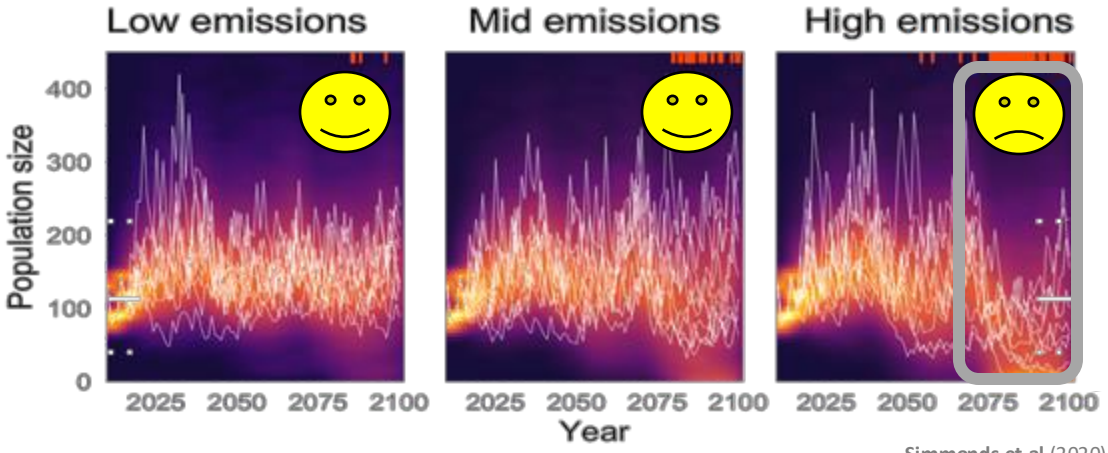
Using statistical models to predict responses to environmental change




- **Keywords:** Driver identification, Bayesian modelling, uncertainty quantification, forecasting, climate change, population change

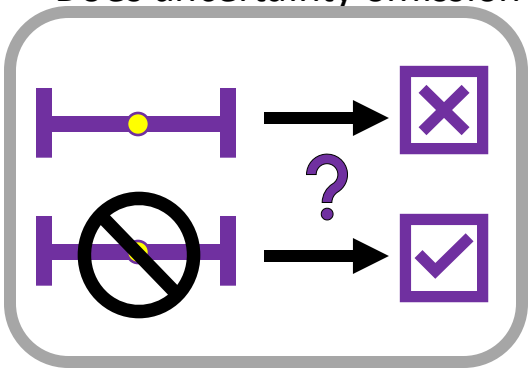
# 3) Illustrative examples

Population size predictions under climate change

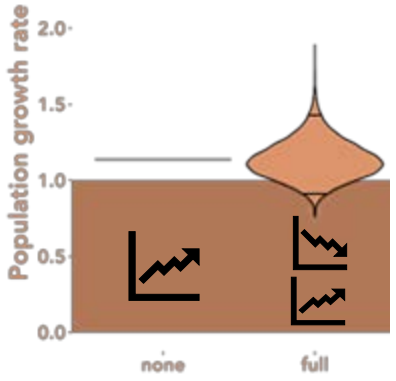



Simmonds et al.(2020) Ecology Letters

Does uncertainty omission alter conclusions?




Simmonds and Jones (2023) Methods in Ecology and Evolution




70%

# 4) Topics/priorities

How do disease dynamics interact with environmental change to impact populations/demography?

Does including disease dynamics in population models improve predictions?

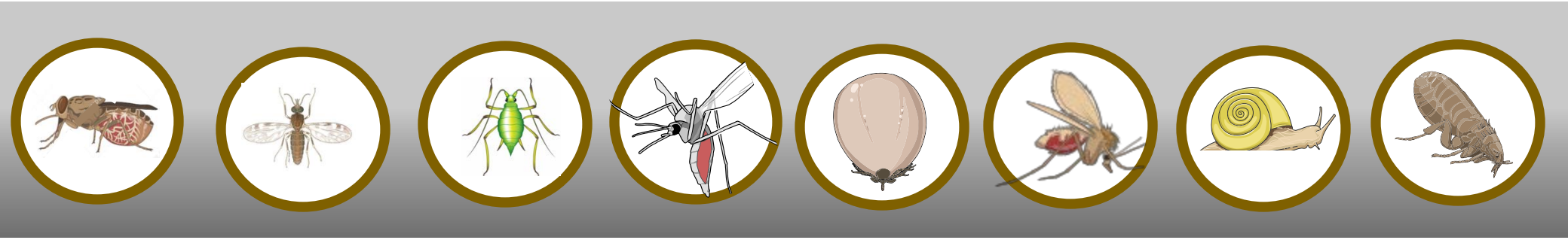
Can identification of environmental drivers improve our understanding of vector borne diseases?

How can we predict disease outbreaks and their impacts?

Anything on uncertainty too

**Interested in further discussion:**
Contact **esimmon2@ed.ac.uk**

# Research intros



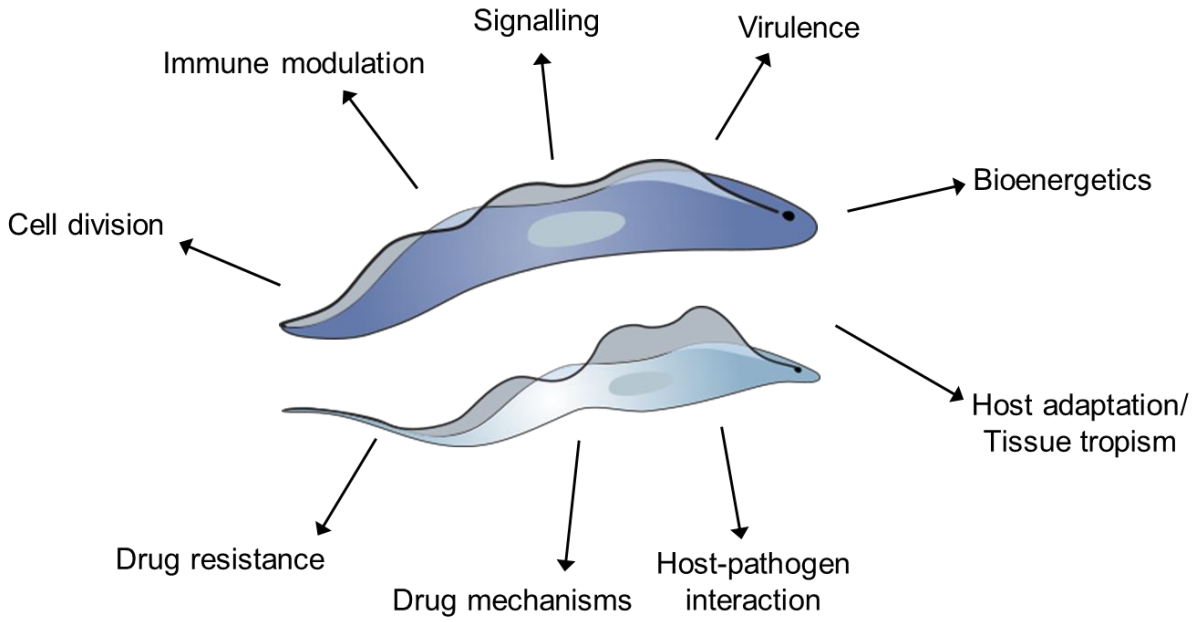
Pieter Steketee

# Pieter Steketee (The Roslin Institute)

## Research topic – Biochemical parasitology

**Research focus: What is the impact of metabolism and metabolic regulation on key phenotypic traits in livestock trypanosomes?**

**Main approach: Developing omics capabilities in African livestock trypanosomes**



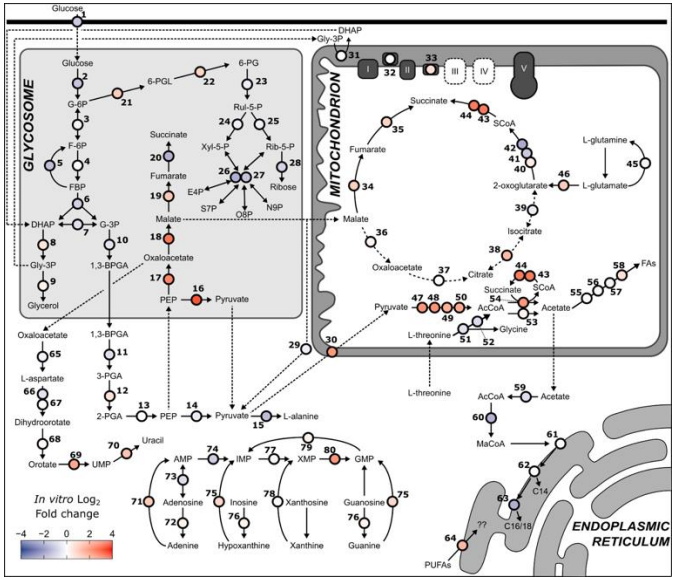

Keywords: Trypanosoma, vector-borne protozoa, metabolomics, proteomics, genetic tools, drug resistance, drug MoA

# 3) Illustrative examples

## 1. Metabolic differences between two closely related trypanosome species

Combination of mass spectrometry and RNAseq to identify similarities and differences in core metabolism between *T. brucei* and *T. congolense*

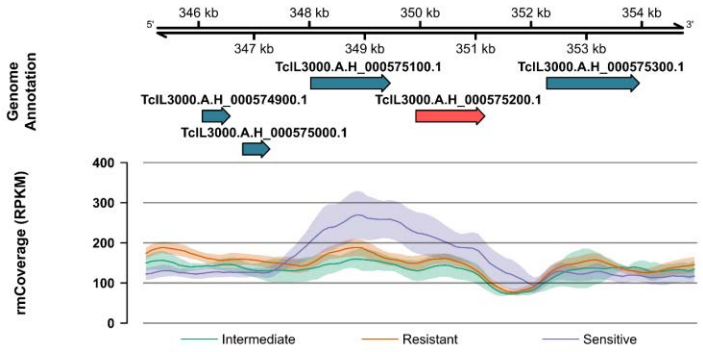
Determine impacts upon sensitivity to metabolism inhibition




## 2. A novel mechanism of isometamidium resistance in African livestock trypanosomes

Copy number of DMT correlates with ISM sensitivity

We have validated DMT as a determinant of resistance in the laboratory.




# 4) Topics/priorities

Fellowship aims:

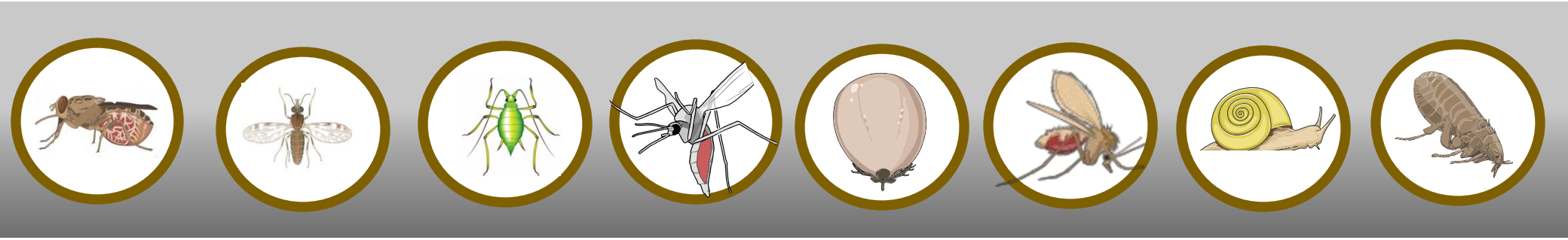
- Characterisation of lipid metabolism in livestock trypanosomes
- Identifying novel drug targets

Other topics/priorities

- Biochemistry!!! ☺
- Expanding vector-borne protozoan research at Roslin Institute/UoE
- Identification of RNA-binding proteins in protozoan parasites
  - (Moonlighting enzymes)
- Excretory/secretory small RNAs as diagnostics for economically important livestock pathogens
- The impact of drug resistance on parasite fitness and transmissibility

**Interested in further discussion:**
Contact **Pieter.Steketee@ed.ac.uk**

# Research intros



Amy Sweeny

# Sweeny Group Institute of Ecology & Evolution, SBS

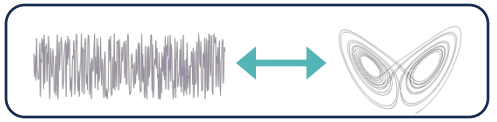
## 1) Wildlife microbiomes and global change

How do changing environments impact within-host communities?

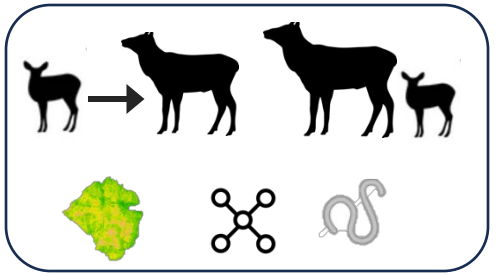
How do microbiome and co-infection interactions shape wildlife disease dynamics?

## 2) Approach – *Community ecology*

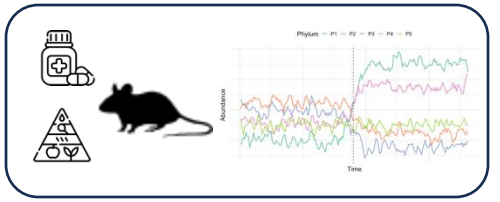
ECOLOGICAL FORECASTING



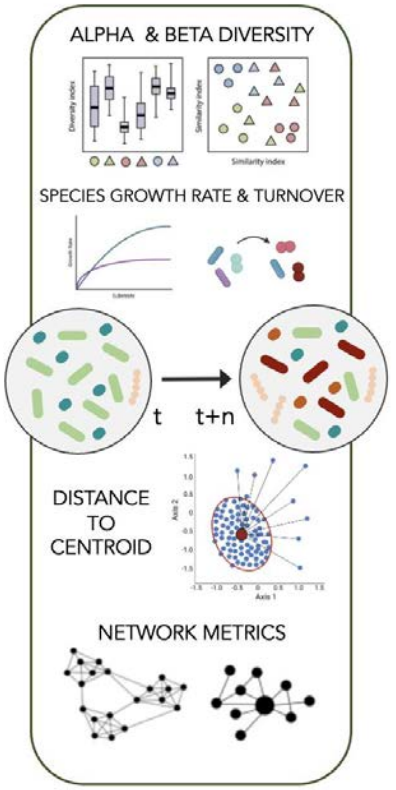
LONG-TERM MONITORING



EXPERIMENTAL PERTURBATIONS

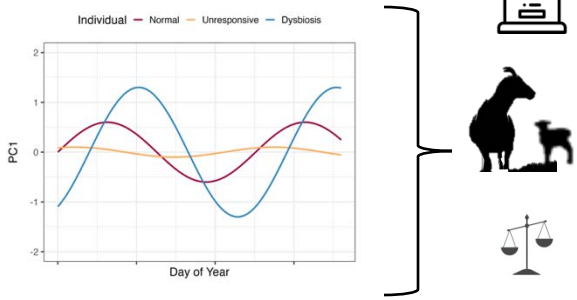


GUT MICROBIOME STABILITY



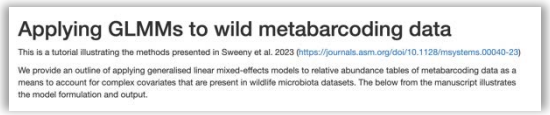
# 3) Examples

## Microbiome stability & host fitness in wildlife









Applying GLMMs to wild metabarcoding data

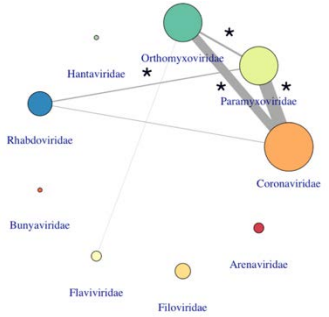
This is a tutorial illustrating the methods presented in Sweeny et al. 2023 (https://journals.asm.org/doi/10.1128/msystems.00040-23)

We provide an outline of applying generalised linear mixed-effects models to relative abundance tables of metabarcoding data as a means to account for complex covariates that are present in wildlife microbiota datasets. The below from the manuscript illustrates the model formulation and output.

https://arsweeny.github.io/microbiome-glmm/

## Parasite community dynamics and disease emergence

USAID PREDICT Data & virus-virus interactions




CONCEPT | Open Access

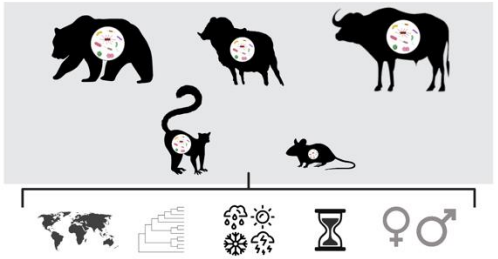
Synzootics

Amy R. Sweeny, Gregory F. Albery, Daniel J. Becker, Evan A. Eskew, Colin J. Carlson

First published: 21 September 2021 | https://doi.org/10.1111/1365-2656.13595 |

## Within-and between-species variation in microbiome dynamics

Longitudinal wildlife microbiome data repository to understand the microbiome as a host trait



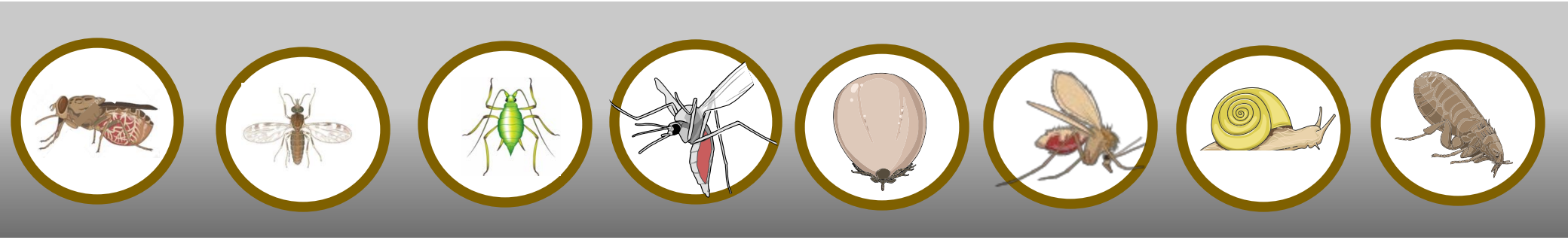
# 4) Topics/priorities

## Future directions

- Microbiome / parasite community dynamics and host fitness
- Vector symbionts and disease transmission
- Vector interactions with host microbiomes
- Perturbation to host microbiomes and impacts for disease dynamics
- Can we predict microbiome response to environmental change?

Interested in further discussion:
Contact amy.sweeny@ed.ac.uk

# Research intros



Pedro Vale

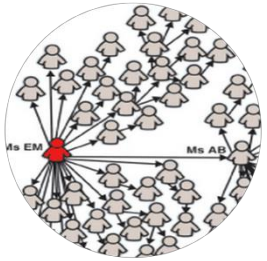
# ValeLab

INSTITUTE OF ECOLOGY AND EVOLUTION, SCHOOL OF BIOLOGICAL SCIENCES

## 1) ECOLOGICAL AND EVOLUTIONARY DYNAMICS OF INFECTION

The overall aim of our research is to understand how individual-level host heterogeneity scales up to population level disease outcomes.

Drivers of heterogeneity in disease-related traits




Epidemiological consequences of host heterogeneity

Behavioral responses to infection

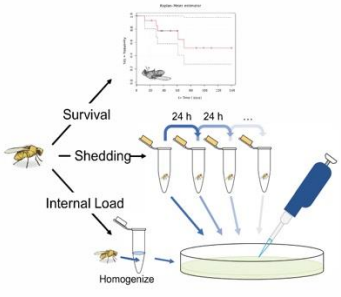
We use the fruit fly *Drosophila melanogaster* as an established model of infection, immunity and behaviour.

## KEYWORDS

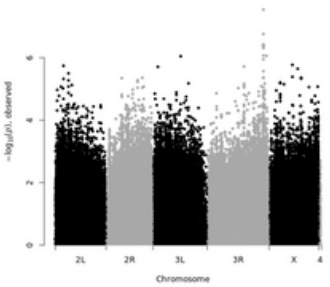
Heterogeneity; pathogen transmission; super-shedding; disease tolerance; avoidance behavior; experimental evolution; experimental epidemics

## 2) APPROACH

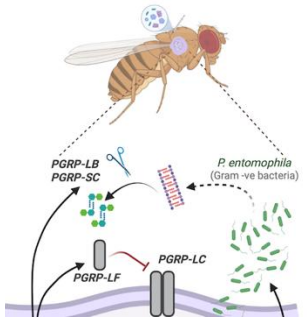
We take an experimental approach to investigate the causes of **individual heterogeneity** in **immune responses, life-history traits** and **social behaviours** and the consequences of this heterogeneity for how pathogens might **spread** and **evolve.**



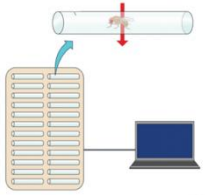

Systemic and enteric bacterial and viral infections

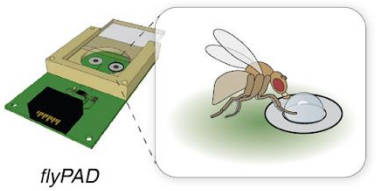


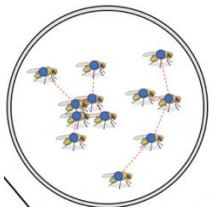

Genetic variation / GWAS




Functional genetics



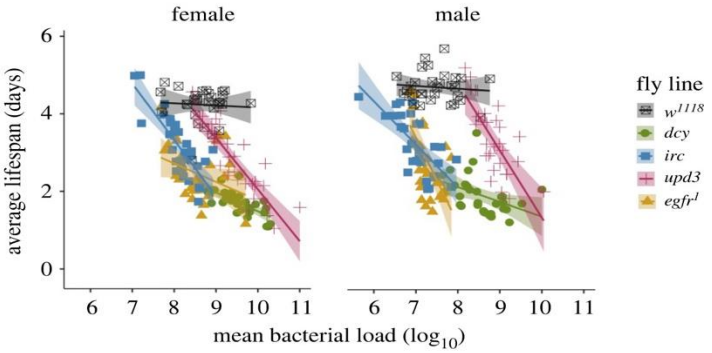


High throughput ethomics (feeding rate; locomotor activity; choice assays)

## 3) ILLUSTRATIVE EXAMPLES

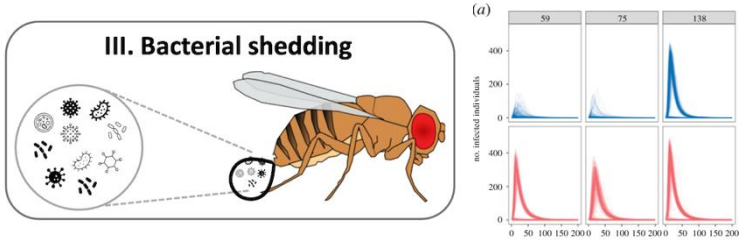
### GENETIC VARIATION AND IMMUNE REGULATION OF DISEASE TOLERANCE



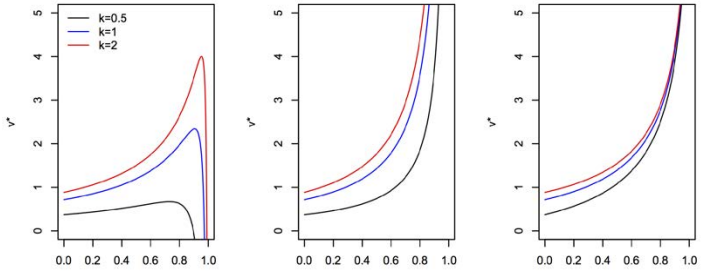

Prakash et al. Proc B. 2022
Kutzer et al. Open Biology 2023
Prakash et al. Dev. Comp. Immunology 2024
Salminen et al. PLOS Genetics 2024

### EPIDEMIOLOGICAL CONSEQUENCES OF HOST HETEROGENEITY

Susi et al. Nature Comms. 2015
White et al. Proc B. 2020
Prakash et al. PLOS Pathogens 2024




### GENETIC AND EVOLUTIONARY DRIVERS OF EXTREME PATHOGEN TRANSMISSION

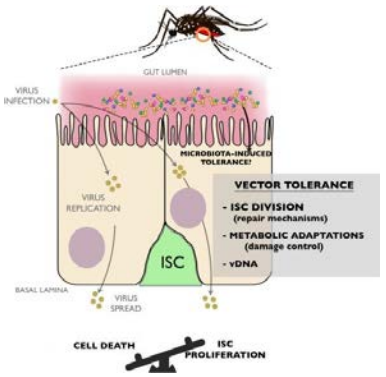



Vale et al. PLOS Biology 2014
Siva-Jothy & Vale. PLOS Pathogens 2021
BBSRC Grant 2025-2029.

Biotechnology and Biological Sciences Research Council

## 4) TOPICS/PRIORITIES

How are arbovirus vectors able to tolerate infection?



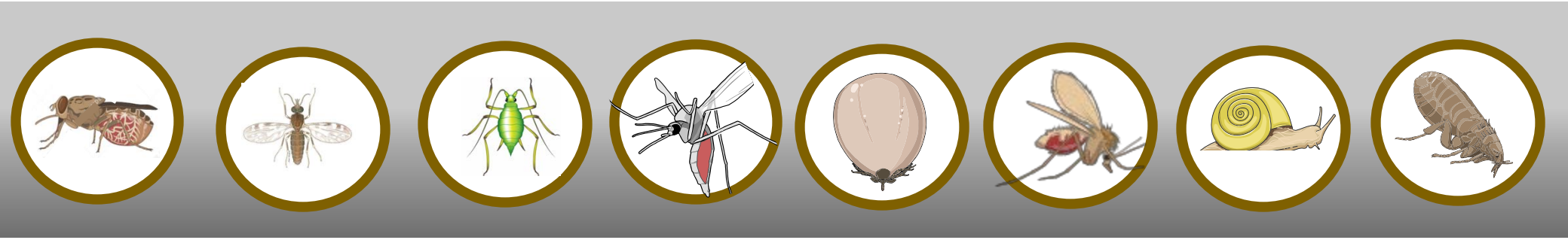

Oliveira, J.H., Bahia, A.C. & Vale, P.F. 2020. *Developmental & Comparative Immunology* **103**: 103514.

José Oliveira, UFSC, Brazil and CNRS

- How do ecological interactions between pathogens drive variation in pathogen transmission?
- How does variable infection history impact epidemic outcomes?
- Which traits (immune / behavioural) drive transmission dynamics?
- The immune regulation of heterogeneity in pathogen transmission.

**Interested in further discussion:**
Contact pedro.vale@ed.ac.uk

# Research intros



Gary Watmough

# Geospatial Livelihoods Group, School of Geosciences

**1) Research topic –** developing & operationalising methods to use EO data and geospatial methods to provide more frequent, high-resolution data on health, poverty, wellbeing

**Impacts**

**Children's climate risk index**
**6 Years of collaborations with UNICEF**


**2) Approach – Domain knowledge led not data driven**

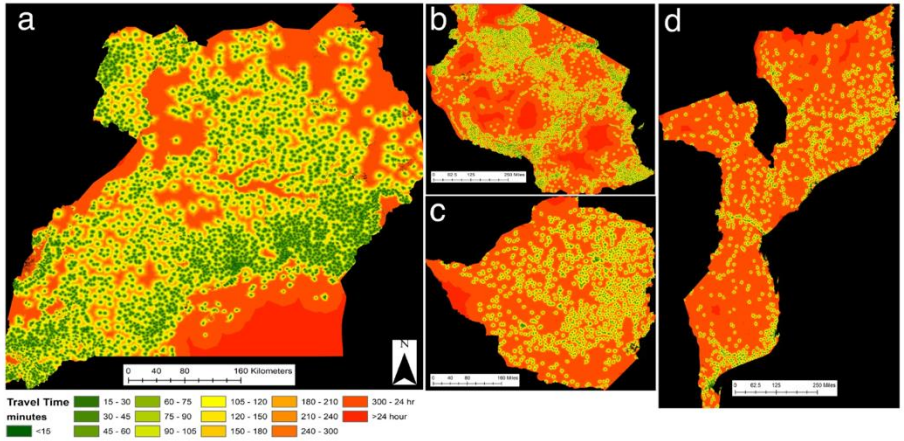
**Summary**

1. Work with local experts to develop models – not just big black boxes
2. Qual and Quant approaches combined.

## 3) Illustrative examples

**Estimating travel time to health centres in Africa**

- 54 countries across Africa – 100 m spatial resolution
- All available on [Humanitarian Data Exchange]




- Model is published – can be adapted, can alter the spatial resolution of the input and output.
- All the data is open source
- Can change the locations to measure markets, hospitals, etc
- Model runs on laptop in python.
- More info: https://www.nature.com/articles/s41597-022-01274-w

## 4) Topics/priorities

Happy to collaborate on projects that might need geospatial data/methods

Interested in the links between climate, health, deprivation, poverty.

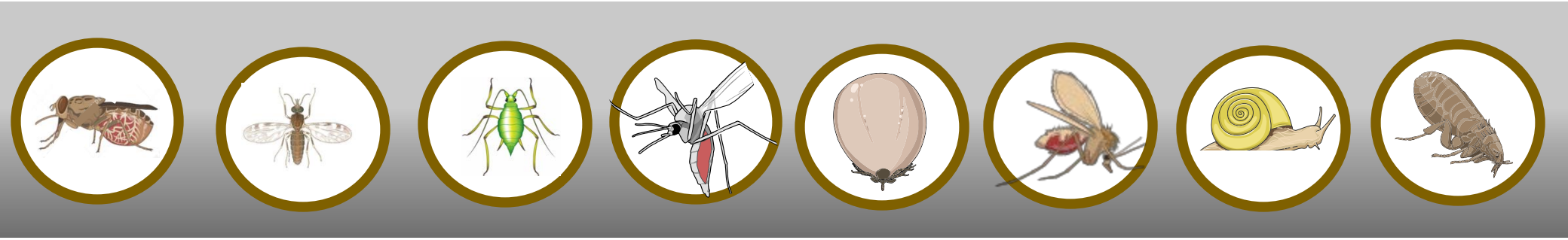
Waiting to hear from UNICEF on LTA for UoE having preferred bidder status to provide geospatial consultancy

**Interested in further discussion:**
Contact gary.Watmough@ed.ac.uk

# Facilities & Resources

- **Lysimachos Zografos**: Edinburgh Innovations
- **Amy Pedersen**: Wood mice in the wild and lab at Kings Buildings
- **Catherine Oke**: Malaria mosquitoes at Kings Buildings
- **Craig Christie:** Tsetse flies at Roslin
- **Chris Proudfoot**: LARIF (Large Animal Research & Imaging Facility), Roslin
- **Beckie Marsland**: Social sciences expertise and data resources
- **Kathie Dirsmith:** SEBI-L (Supporting Evidence Based Interventions in Livestock)
- **Gianluigi Rossi**: EPIC (Epidemiology, Population health and Infectious disease Control)
- **Gail Jackson**: Fields and farms at SRUC and James Hutton Institute
- **Mara Rocchi**: Model systems at Moredun
- **Emma Cunningham**: Centre for Adapting to the Changing Environment

# Research intros



Lysimachos Zografos

# EI ECR Team

- **Edinburgh Innovations is the University's commercialisation service.**
- **The EI ECR Team offers bespoke support to ECR-led projects**
- **Support can include internal and external translational funding, mentorship, Entrepreneur-in-Residence support, planning, identifying and engaging stakeholders**

**More information at**
**https://uoe-edinburgh-innovations.ed.ac.uk/for-staff/ecr-support**

THE UNIVERSITY of EDINBURGH

EDINBURGH INNOVATIONS

ECR TRANSLATIONAL COMMUNITY

# ECR SEED FUNDING

**UP TO £10K AVAILABLE PER PROJECT FOR ECR-LED TRANSLATIONAL PROJECTS WITHIN HUMAN HEALTH AND WELLBEING**

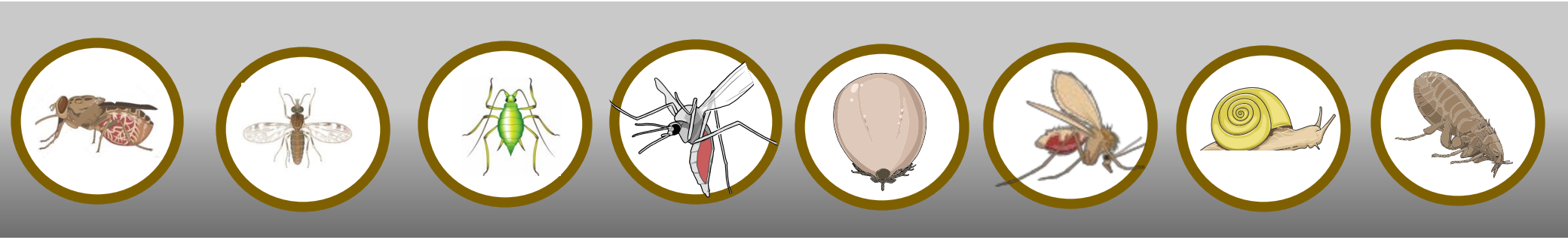
**APPLICATIONS DUE APRIL 17TH 2025**

THE UNIVERSITY of EDINBURGH

EDINBURGH INNOVATIONS

**ECR TRANSLATIONAL COMMUNITY**

# Facilities and resources



Amy Pedersen

# Wild-to-lab mouse facilities

THE UNIVERSITY of EDINBURGH

Species:

- **Wood mice** *(Apodemus sylvaticus)*
  - Wild-like gut microbiome
  - Lab-like gut microbiome
- **House mice** *(Mus musculus)*

Access wild-derived, outbred wood mice for use in our facilities or can be moved to to other facilities

Regular capture and longitudinal monitoring of wild wood mice, house mice, bank voles, etc.

Maintain wild-derived parasites/pathogens

**Where is the wood mice colony?**


**Where are the wild mice?**

# What do we do?

**Experiments in lab and wild**
- Infection/coinfection
- Vaccination
- Nutrition
- Immunology, etc.

**Sample sizes**
- In the laboratory colony – we can host experiments up to ~75-100 mice at a time
  - Individual or group housing
- In the wild, the experiments can be larger, run across the year/several sites etc.

**Types of data collected**
- We collect ticks and fleas from wild rodents and have lots stored in the freezer
- We regularly monitor >30 parasites and pathogen *sps.* that infect the mice
- Blood, tissue and faecal samples
- Nutritional content
- Survival, body condition, function
- Movement patterns, ageing

# What training can we offer?

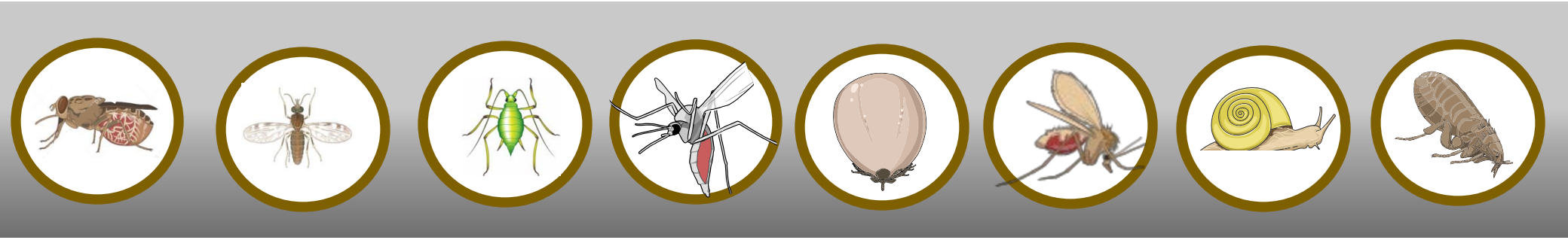
- Wood mouse colony support
- Wild rodent trapping
- Vector or wild rodent samples from our field sites

## Other uses?

- Tick infection/transmission
- VBP infection
- Vector genomics
- Vector immunity

**Want to use this facility and/or field samples?**
Contact Amy Pedersen: amy.pedersen@ed.ac.uk

# Facilities and resources



Catherine Oke

# Mosquito insectaries

Species:

- *Anopheles stephensi*
- *Anopheles coluzzii*

CL 1

Access to incubators for L:D/seasonal/temp/humidity manipulations

Blood-feeding available via mice / membrane feeding *(e.g. using artificial blood, horse blood)*

**Where are we?**


**Want to use this facility?**
Contact Aidan O'Donnell: Aidan.Odonnell@ed.ac.uk

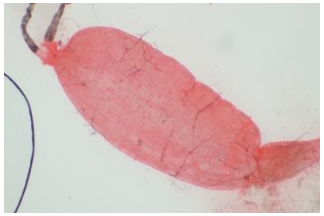
## What do we do?

**Experiments**

- Malaria/mosquito interactions
  - Circadian rhythms
  - Parasite development
- Mosquito life history traits

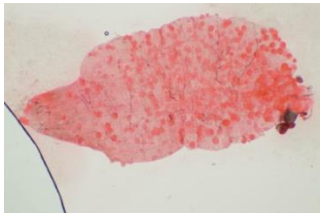
**Sample sizes**

- Often >2500 mosquitoes per experiment
- Cages / pots / individual housing



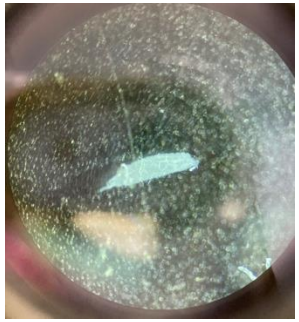
**Types of data collected**

- Parasite counts (from head/thorax and midgut)
- Nutritional content
- Survival
- Fecundity measures (egg lay/hatch rate)
- Activity monitoring (LAMS)



## What training can we offer?

- Mosquito dissection



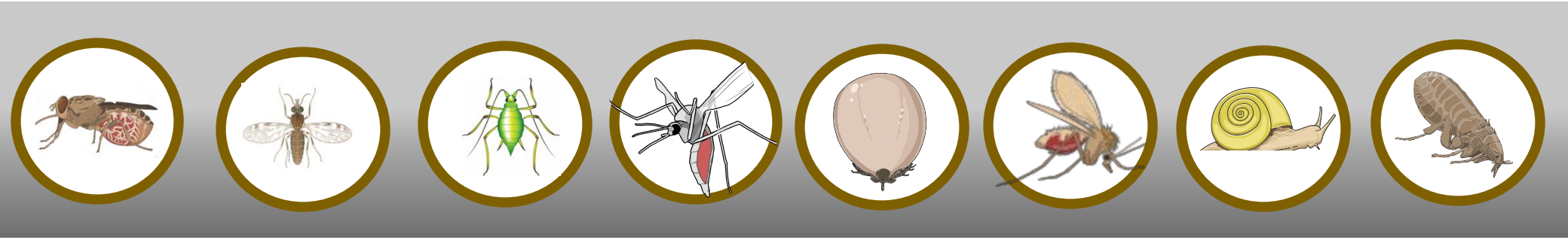
## Other uses?

- Vector behaviour
- Vector genomics
- Vector immunity
-

**Want to use this facility?**

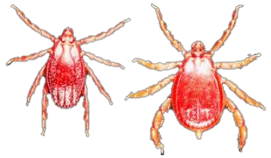
Contact Aidan O'Donnell: Aidan.Odonnell@ed.ac.uk

# Facilities and resources

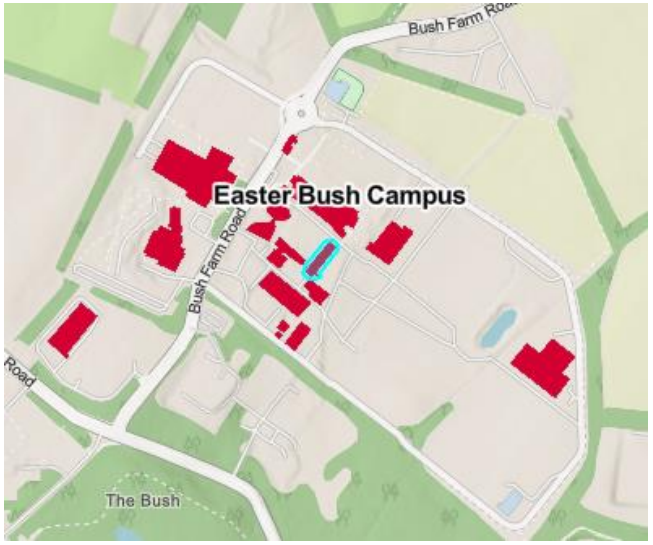


Craig Christie

# The Roslin Vector-borne-disease Research Facility

| Arthropod vector | Pathogen |
|---|---|
|  *R. appendiculatus* | *T. parva* |
|  *H. excavatum* | *T. annulata* |
|  *R. microplus* | *Babesia spp.* |
|  *G. morsitans* | *T. brucei*<br>*T. congolense*<br>*T. vivax* |

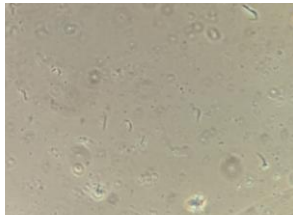
**Host**



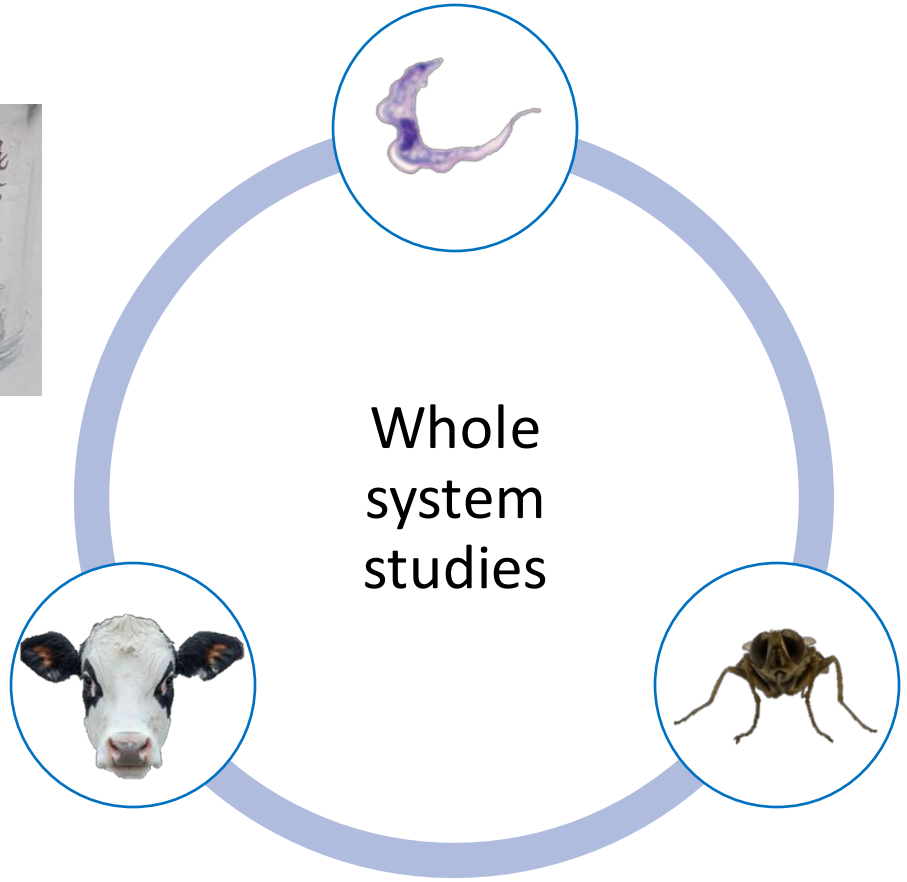
# What can we provide?

Provision of research material

Tsetse infection and transmission of trypanosome spp.



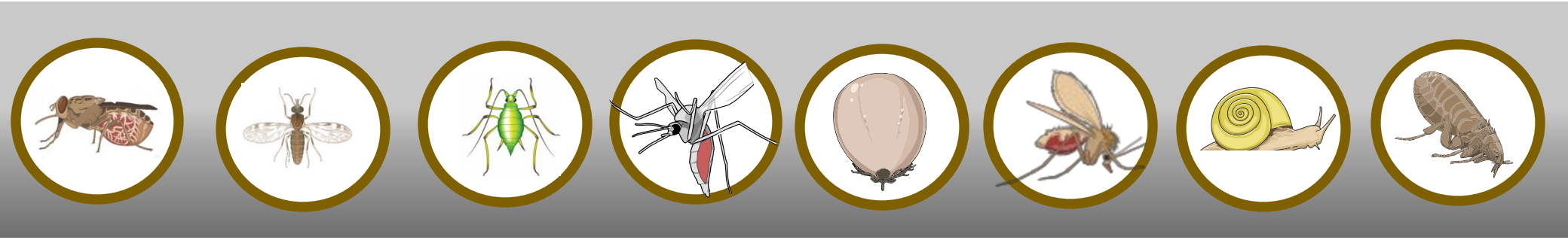
Establishment of tsetse-cow transmission:
4-6 months




*In vitro* feeding system for ticks

**Collaboration is welcome!**
**Any questions, please contact:**
**craig.christie@ed.ac.uk**

# Facilities and resources



Chris Proudfoot

# The Large Animal Research & Imaging Facility

LARIF

THE UNIVERSITY of EDINBURGH
The Royal (Dick) School of Veterinary Studies

Livestock species:

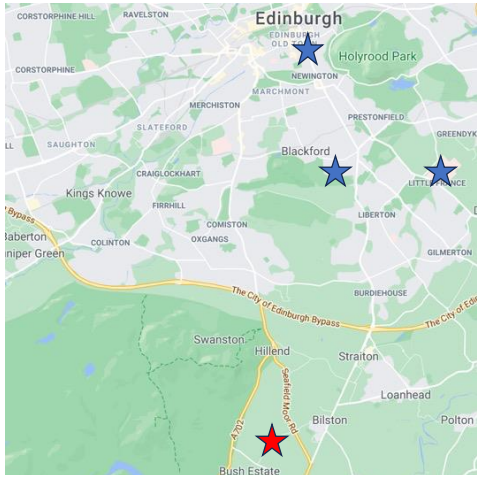
- Cattle
- Pigs
- Sheep

Facilities:

- Animal Holding
- Environment control rooms
- Cat 2 containment suites
- 2 Surgical suites
- 4 bed Critical Care Unit
- Imaging suite

Studies:

- Vaccine development
- Medical device testing
- TG/GE model generation




UK Agri-Tech Centre

# Cat 2 containment suites

<u>Facilities:</u>

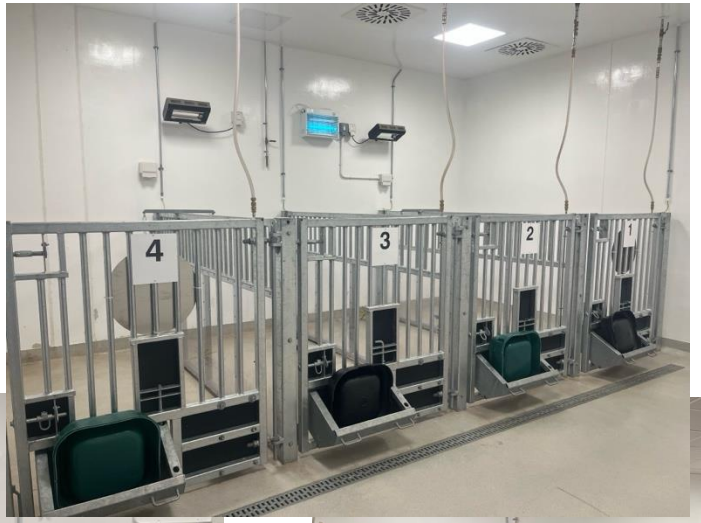
- 3 pen room & 4 pen room
- Change on entry (shower)
- Drains can be capped
- Air – HEPA filtered
- Procedure rooms

<u>Studies:</u>

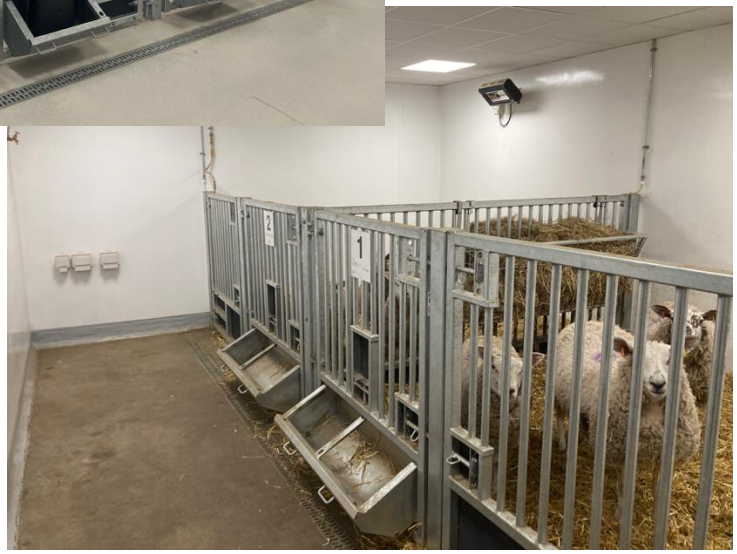
- Pig UTI
- TGEV
- Salmonella challenge

<u>Vector proof rooms:</u>

- 2 pen room & 4 pen room
- Entry vestibule
- Trypanosome challenge



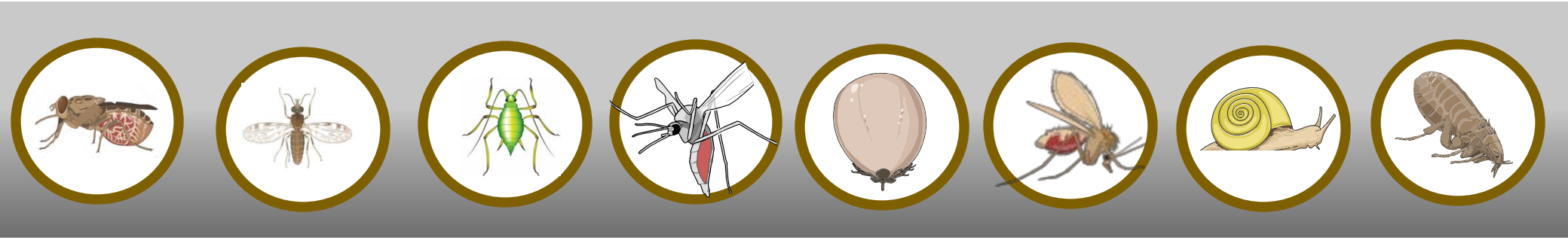





**Want to use this facility?**

Contact LARIF@ed.ac.uk

# Facilities and resources



Beckie Marsland

Vector borne diseases emerge from complex social, political, and environmental systems. If you are looking for this kind of expertise – CAHSS offers a wide breadth of options for research collaboration. There are nine interdisciplinary research themes across our College, including Health and Wellbeing, and Energy and Sustainability.


**Health and Wellbeing**

- Centre for Biomedicine, the Self and Society
- Edinburgh Centre for Medical Anthropology (includes Health and Environment network)
- Global Health Policy Unit
- INNOGEN
- Mason Institute for Health, Society and the Law
- Medical Humanities Network
- One Health Archaeology Research Group
- School of Health in Social Science
- Science, Technology and Innovation Studies

**Climate Change and Environment**

- Centre for Business, Climate Change, and Sustainability
- Environmental Humanities Network
- Center for Future Infrastructure
- Open Space
- Sus +

**Regional expertise:** Centre for South Asian Studies, Centre of African Studies, Social Anthropology, Centre for Contemporary Latin American Studies, Latin American Studies, Islamic and Middle Eastern Studies

# Research collaboration: Understanding Social Systems for Vector Borne Disease

**1. Multiple Ways of Knowing**
- Indigenous knowledge systems reveal long-term environmental changes affecting vector habitats
- Experiential knowledge identifies emerging disease patterns
- Historical analyses of how colonial practices shape disease landscapes

**2. Methodological Innovation**
- Participatory mapping tracks vector habitat changes
- Community-based monitoring systems
- Ethnographic methods uncover why interventions succeed or fail
- Arts-based approaches enable new forms of community engagement with disease prevention

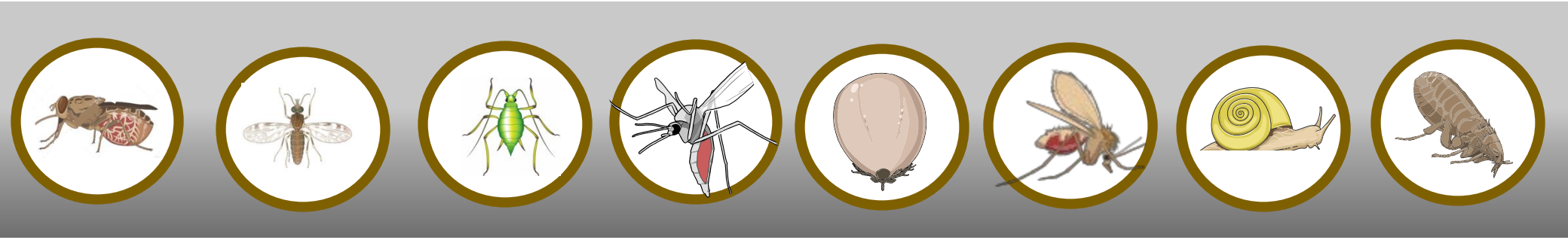
**3. Power and Knowledge Production**
- How different forms of expertise are valued or marginalized
- Ways that social inequalities (eg. migration) shape both disease vulnerability and research priorities
- Role of community participation in redefining what counts as evidence
- Integration of local knowledge with policy development

# Where to go for Ethics, Design, Policy, and Translation

These emerge from a deep understanding of social systems:

- **Ethics:** Center for Biomedicine, the Self and Society; Mason Institute for Health, Society and the Law; School of Health in Social Science, School of Social and Political Science
- **Design:** Edinburgh College of Art (Landscape Architecture; Design)
- **Policy:** Global Health Policy Unit; Centre for Science Knowledge and Policy at Edinburgh
- **Translation/KEI:** INNOGEN ; School of Health in Social Science; School of Social and Political Science
- **Research Methods:** Binks Hub (community/arts-based methods for social change); Social Science research methods: Research Training Centre

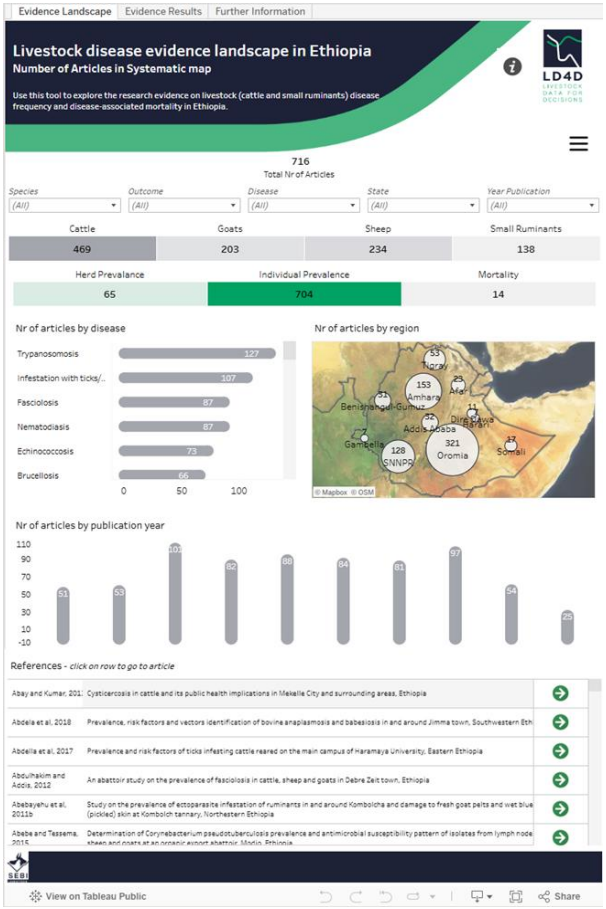
# Facilities and resources



Katie Dirsmith

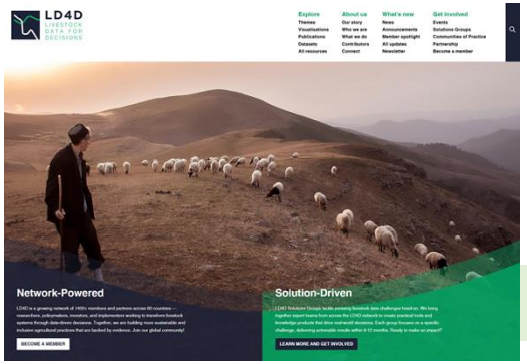
# LitXpress:
# An Evidence Synthesis Tool

SEBI LIVESTOCK
Centre for Supporting Evidence-Based Interventions in Livestock

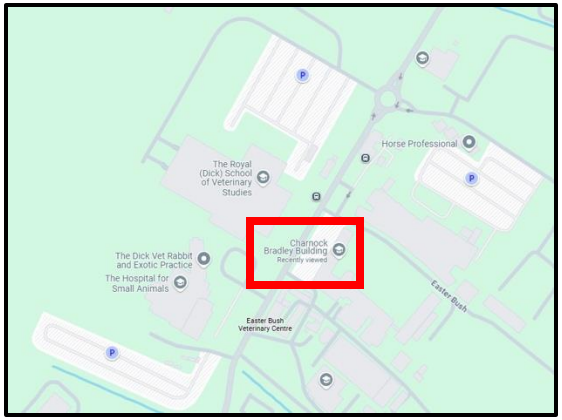



- Currently in development by SEBI-Livestock and EDINA
- Purpose: To increase the efficiency (while maintaining the quality) of evidence synthesis projects that help inform internal models and aid external user decision making
- Automates the following for the evidence synthesis of livestock health literature
  - Database searching
  - Article retrieval
  - Deduplication
  - Machine classification
  - Data extraction and visualisation
- Provides an interface for user screening and kappa testing metrics

https://livestockdata.org




Charnock Bradley Building
Easter Bush Campus



SEBI LIVESTOCK
Centre for Supporting Evidence-Based Interventions in Livestock

## What do we do?

**Studies**

- Past
  - Systematic map of infectious livestock disease prevalence and mortality in Ethiopia
- Current
  - Systematic review of infectious livestock disease prevalence, incidence, and mortality in Tanzania
- Future
  - Systematic review of 12 infectious diseases + endoparasites and ectoparasites in Africa and South Asia and their prevalence, incidence, mortality, and morbidity

**Sample sizes**

- Tool can retrieve and classify an unlimited number of articles

**Types of data collected**

- Searches Web of Science, Scopus, PubMed, and Google Scholar
- Number of articles retrieved by publication year and country displayed after query is run

## What training can we offer?

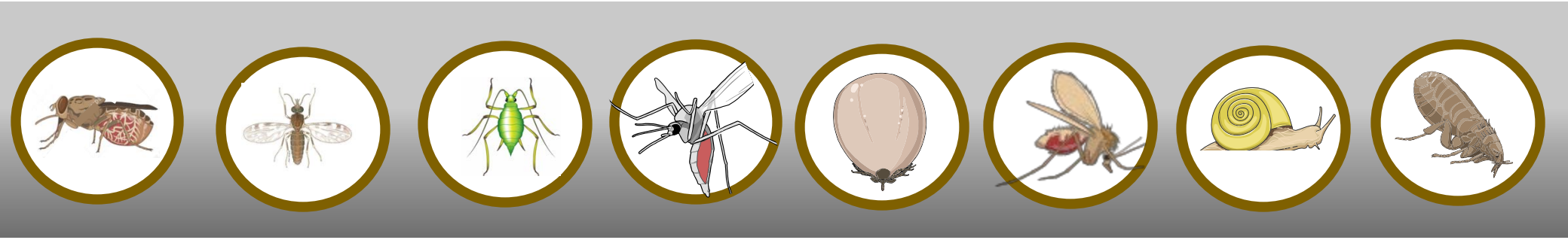
- Tool currently in development, but planned to be accessible in future to the wider research community
- Training information offered at that time

## Other uses?

Once developed, tool can be used by researchers to partially automate the evidence synthesis process for livestock disease queries

**Contact details for more information:**
Louise Donnison: louise.donnison@ed.ac.uk
Vlad Cherman: vlad.cherman@ed.ac.uk
Katie Dirsmith: katherine.dirsmith@ed.ac.uk
https://sebi-livestock.org/

# Facilities and resources



Gianluigi Rossi

07/02/2025

epic | Centre of Expertise on Animal Disease Outbreaks

# Vector-borne disease research in EPIC

Gianluigi Rossi

EPIC & Roslin Institute

University of Edinburgh

OUR PARTNERS

BioSS · The James Hutton Institute · Moredun · Roslin Innovation Centre · SRUC · The University of Edinburgh Global Academy of Agriculture and Food Security · University of Glasgow · Scottish Rugby

# EPIC: Centre of Expertise on Animal Disease Outbreak

What is EPIC? → A multidisciplinary consortium, funded by the Scottish Government, focused on research and controlling animal disease outbreaks to protect Scotland's livestock.

Expertise in veterinary epidemiology, ecology, modelling, phylogenetics, parasitology, microbiology, data analysis, social science, rural economy

→ Investigate endemic diseases (e.g. scrapie, liver fluke)
→ Response to incoming epidemic (e.g. Avian flu, BTV)
→ Preparedness for exotic threats (e.g. ASF, FMD)
→ Support evidence-based policy making

Our work include **vector-borne diseases** and the **response to emerging threats due to climate change**

**Consortium members**

SRUC
University of Glasgow
ROSLIN
THE UNIVERSITY of EDINBURGH Global Academy of Agriculture and Food Security
BioSS
Moredun Research Institute
The James Hutton Institute

**Main locations:**
Glasgow, Edinburgh (KB+EB), Inverness, Aberdeen

# Example 1: policy makers advice



## Understand consequences of restricting animal movements in different snap-out zones

Objective: reduce risk of spreading **Blue-Tongue virus** (BTV) in the Scottish cattle and sheep herd

BTV: spread by Culicoides (i.e. midges)

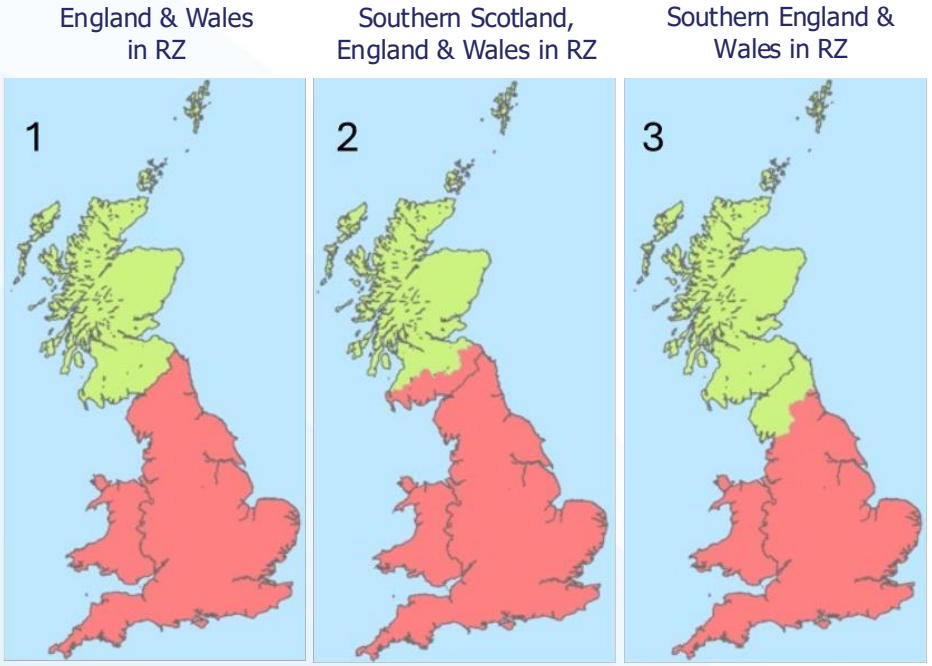
Epidemic started in SE England, coming from infected insects brought in by wind from continental Europe

Questions arose on how to implement movement restrictions, where to set boundaries

Analysed cattle and sheep movement patterns in 2018-2023

Work done by **Sibylle Mohr** (UoG)

Animals move from the green area to the red areas, but are restricted the other way



# Example 2: vector surveillance



## Midge surveillance in Scotland in response to BTV spread by Culicoides midges 2024 Pilot project

Kirkton Farm, Crianlarich, Highland

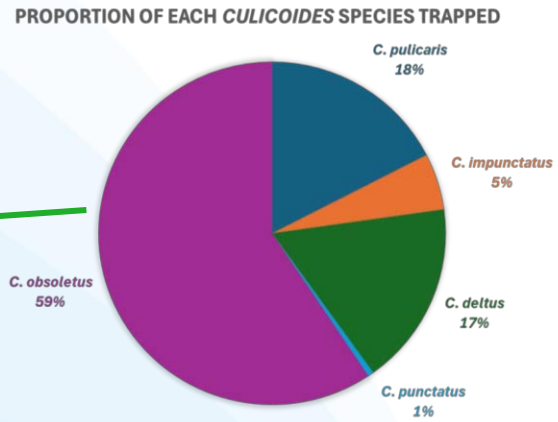
Work done by
**Jack Hearn** (SRUC)

Project Partners:


Key outcome:

Potentially declare Seasonal Vector Free Period **8-10 weeks** before England.

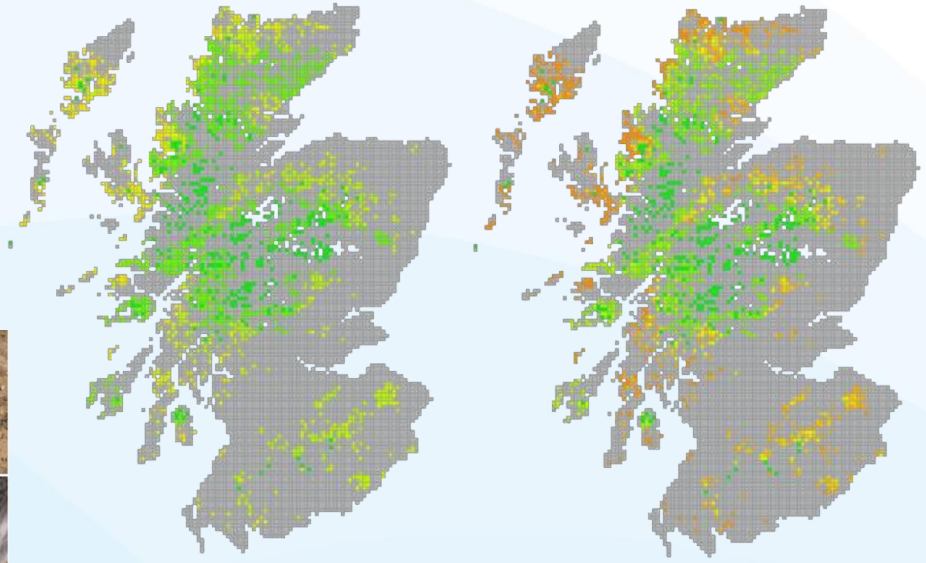
South farm (most at-risk):



# Example 3: future scenarios analyses

## Predicted increase in risk of *Louping-ill virus* in many parts of Scotland

**Recent climate** **2.5°C warming**



Warmer colour → higher risk

**Louping-ill →**
acute viral disease
RNA virus
Affecting primarily sheep
Main vector: *Ixodes ricinus* tick

Work done by **Lucy Gilbert** (UoG)
in EPIC III

UNIVERSITY of STIRLING

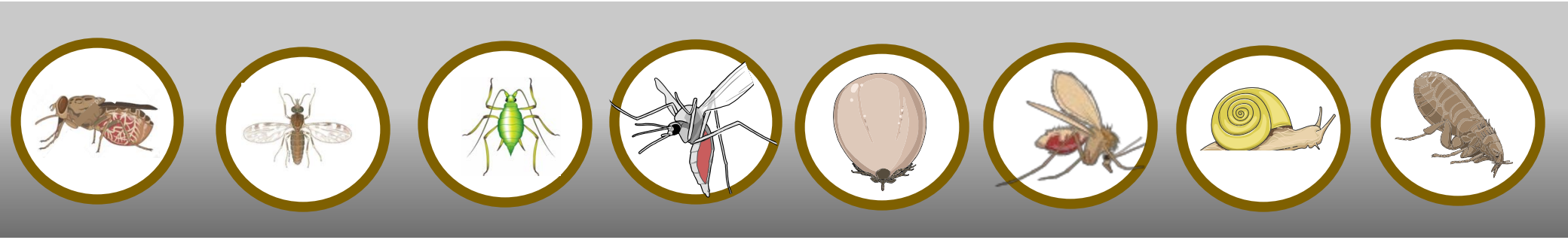
University of Glasgow

epic | Centre of Expertise on Animal Disease Outbreaks

# Thank you

www.epicscotland.org
Epic.Scotland@ed.ac.uk
g.rossi@ed.ac.uk

# Facilities and resources



Gail Jackson

# Facilities Used by Agroecology at Edinburgh

**SRUC insectary at King's Buildings**

Day/night photoperiod control

PAR = 150 um $m^{-2}$ $s^{-1.}$ Sustains plant growth

Temperature control (Currently 18 C, day and night)

Insect chambers – 8 high quality. Well ventilated, and 'insect proof' (50 x 50 x 70 cm)

Used to culture aphids and parasitoid wasps. Long term experiments

**SRUC glasshouse at KB**

Supplementary lighting

16 hour photoperiod

Temperature control

# Facilities Used by Agroecology at Edinburgh

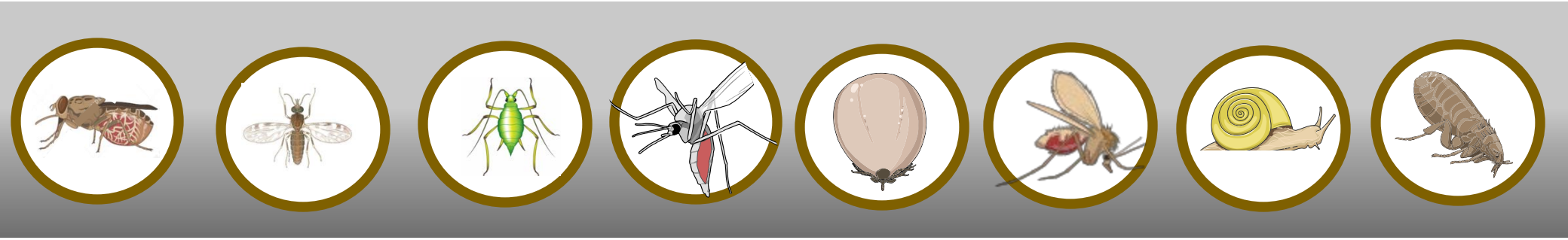

**The Centre for Sustainable Cropping** at Balruddery, Dundee.
A long-term platform for research on sustainable arable systems.
Monitoring in three cereal crops, for aphids, wasps, BYDV

The James Hutton Institute

**Berryhill Farm, JHI, Dundee**
Also (not pictured) **Boghall Farm**, 7 miles south of KB
Managed by SRUC.
Funded by RESAS

**Contact details for accessing facilities**
Gail Jackson (G.Jackson@ed.ac.uk)

# Facilities and resources

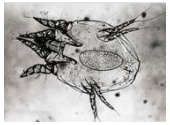


Mara Rocchi

# Moredun Research Institute facilities




**Hard ticks:** negative pressure CL2 laboratory for tick processing; equipment and protocols for NA extractions. TBDs diagnostic. CL3 animal rooms (3X) for *in vivo* challenge (LIV). CL3 labs for *in vitro*.

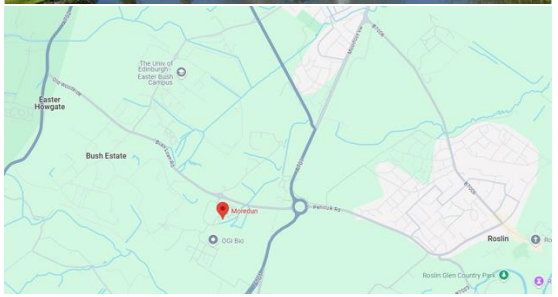


***Psoroptes ovis:*** dedicated biosecure sheep scab facility (house up to 60 sheep/4 pens) for in vivo work; dedicated CL2 harvesting and testing laboratory

***Dermanyssus gallinae:*** dedicated biosecure challenge facility with specialised protocols for mite feeding *in vivo. In vitro* mite feeding, harvesting and processing labs.

***Galba truncatula:*** protocols for snail collection (field), maintenance *in vitro* (2 weeks) and testing for cercariae shedding (*Fasciolae* and *CalicophoroIn*)

**Where is Moredun?**


**Want to use this facility?**

mara.rocchi@moredun.ac.uk
info@moredun.ac.uk

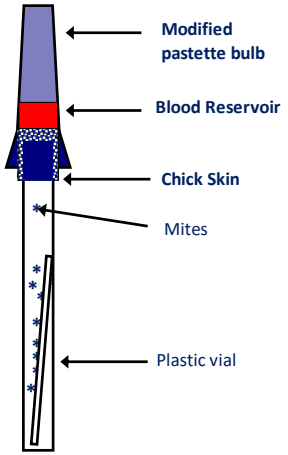
# What do we do?

***In vivo* and *in vitro* studies**

- Maintenance of life cycles in target host; *in vivo* infection and harvesting of mites (diagnostic, vaccines); *in vitro* acaricide resistance studies; *in vitro* pathogen culture at CL3; challenge at CL3


**Sample sizes**

- Sheep 18 @CL3
- Hens: max 80
- Harvest: ~ 1 fleece
- Ticks process: 24
- Ticks NA: 96
- Mites: loads




**Types of data collected**

- Blood
- Serum
- Tissues
- Ticks
- Mites
- Nucleic acids
- Body condition, function
- Clinical data

# What training can we offer?

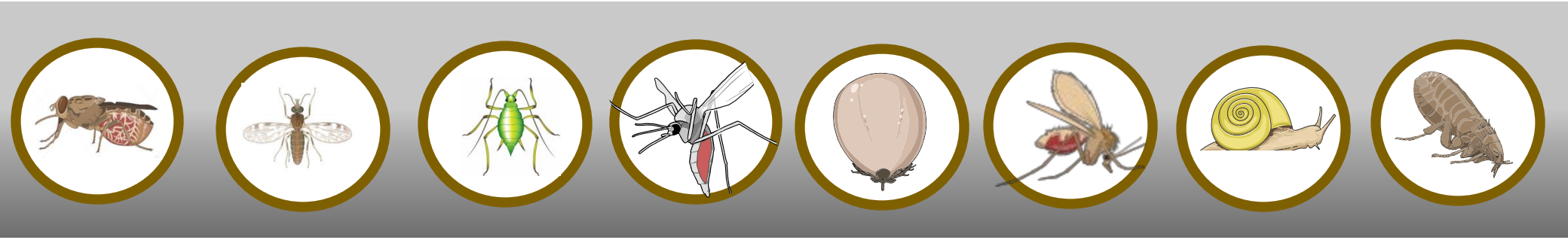
- Molecular and serological techniques
- Access to different NA extraction platforms
- CL3 training for facility access

# Other uses?

- Access to facility/labs and animal room for studies requiring CL2/CL3 containment

**Contact details for accessing facility**
Mara.Rocchi@moredun.ac.uk

# Facilities and resources



Emma Cunningham

THE UNIVERSITY of EDINBURGH

# Centre for Adapting to Changing Environments

Brings together environmental researchers from across the University

Partners with ~30 external organisations working in environmental research

E5 DTP

Edinburgh Earth, Ecology and Environment Engagement Partnership
Doctoral Training Programme

## Partner schools

UoE School of GeoSciences
UoE School of Biological Sciences
UoE School of Chemistry
UoE School of Engineering
UoE School of Informatics
UoE School of Mathematics
UoE School of Physics & Astronomy
UoE School of Veterinary Studies

## Centres of excellence

Edinburgh Centre for Parallel Computing
National Centre for Atmospheric Science
National Centre for Earth Observation

## Research Organisations

Royal Botanic Garden Edinburgh
British Geological Survey
National Museums Scotland
National Physical Laboratory
Scottish Association for Marine Science
Scottish Universities Environmental Research Centre
UK Centre for Ecology & Hydrology
Scotland's Rural College (SRUC)

## Public engagement

Dynamic Earth

## Executive agencies

Forest Research
Met Office

## Public bodies

NatureScot
Scottish Environmental Protection Agency
Animal and Plant Health Agency
DEFRA

## Industry

Earthwave
Space Intelligence
Space Scotland
Telespazio

## Conservation charities

British Trust for Ornithology
National Trust for Scotland
RSPB
Scottish Wildlife Trust

## Consultancy

Biomathematics and Statistics Scotland
EcoOnline

# Exemplar projects


ECOFLU

THE UNIVERSITY of EDINBURGH
School of Biological Sciences

THE UNIVERSITY of EDINBURGH
The Royal (Dick) School of Veterinary Studies

THE UNIVERSITY of EDINBURGH
School of GeoSciences

ROSLIN

NatureScot
NàdarAlba

Animal & Plant Health Agency

NATIONAL TRUST for SCOTLAND

UK Centre for Ecology & Hydrology

RSPB

BTO
British Trust for Ornithology

University of Glasgow

HERIOT WATT UNIVERSITY

UNIVERSITY OF GLOUCESTERSHIRE

National Trust

UKRI Natural Environment Research Council

# Offering

- A network of environmental expertise
- Links to external collaborators
- Research development support
- Grant submission support
- Workshops around funding calls
- Training
- Early Career network
- Links to policy

**Interested in further discussion:**
environmentalchange@ed.ac.uk