afbi Agri-Food and Biosciences Institute

SHAPING LIVESTOCK FARMING FOR 2030

Prof. Simon More

UCD

www.afbini.gov.uk

bTB eradication by 2030: *reflections from Ireland*

Simon More

Centre for Veterinary Epidemiology and Risk Analysis

University College Dublin

1. My background

Science
(risk assessment)

Policy
(risk management)

Scientific information

Policy decision-making

Provide objective information
(to assist with informed policy-making)

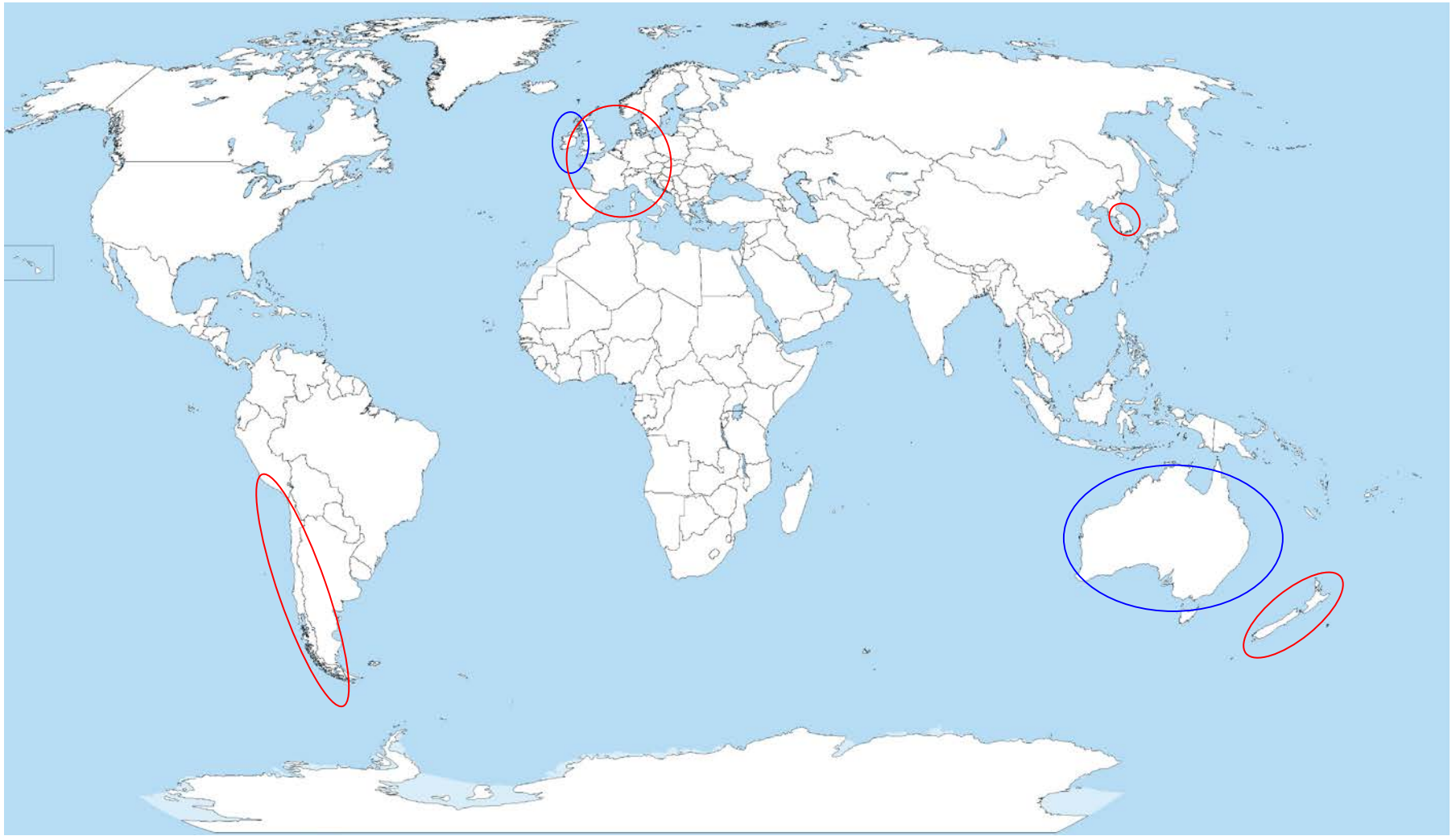
Bovine tuberculosis
BVD
Johne's disease
Milk quality, incl. SCC
On-farm animal welfare incidents

Centre for Veterinary Epidemiology and Risk Analysis (CVERA)

Department of Agriculture, Fisheries and Food
An Roinn Talmhaíochta, Iascaigh agus Bia

AHI Animal Health Ireland.ie

Bovine tuberculosis



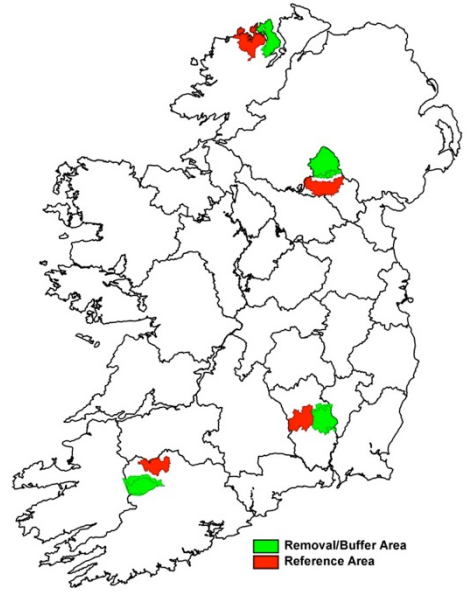
2. bTB research in Ireland

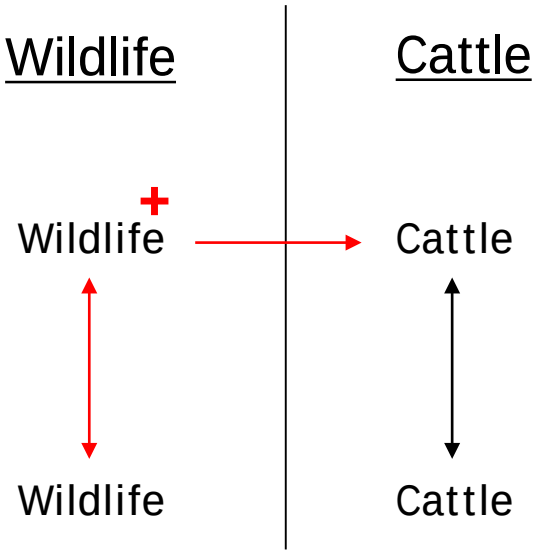
Driving principles

- bTB eradication will only be possible if:
  - We have a good understanding of the overall ‘epidemiological system’:
    - *Which species are infected? What is the role played by each species?*
    - *How infection is transmitted? How infection is maintained?*
    - *What are the main constraints to eradication? How important are they?*
    - *What are the strengths and weakness of current/proposed control strategies? And the impact?*
  - We are able to adequately control all the factors that facilitate maintenance and ongoing spread of infection in the overall system

A multi-host system

East Offaly project
(1989-95)
Four area project
(1997-2002)

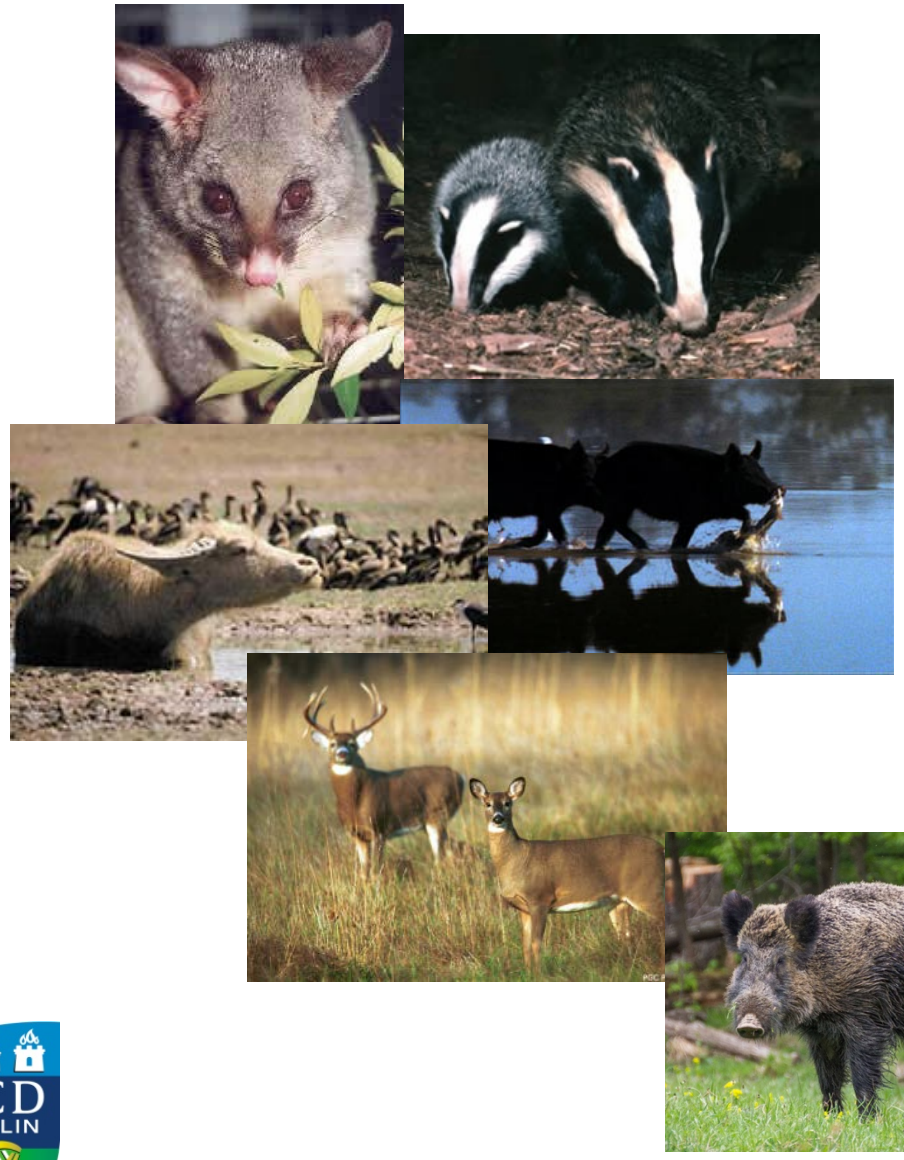


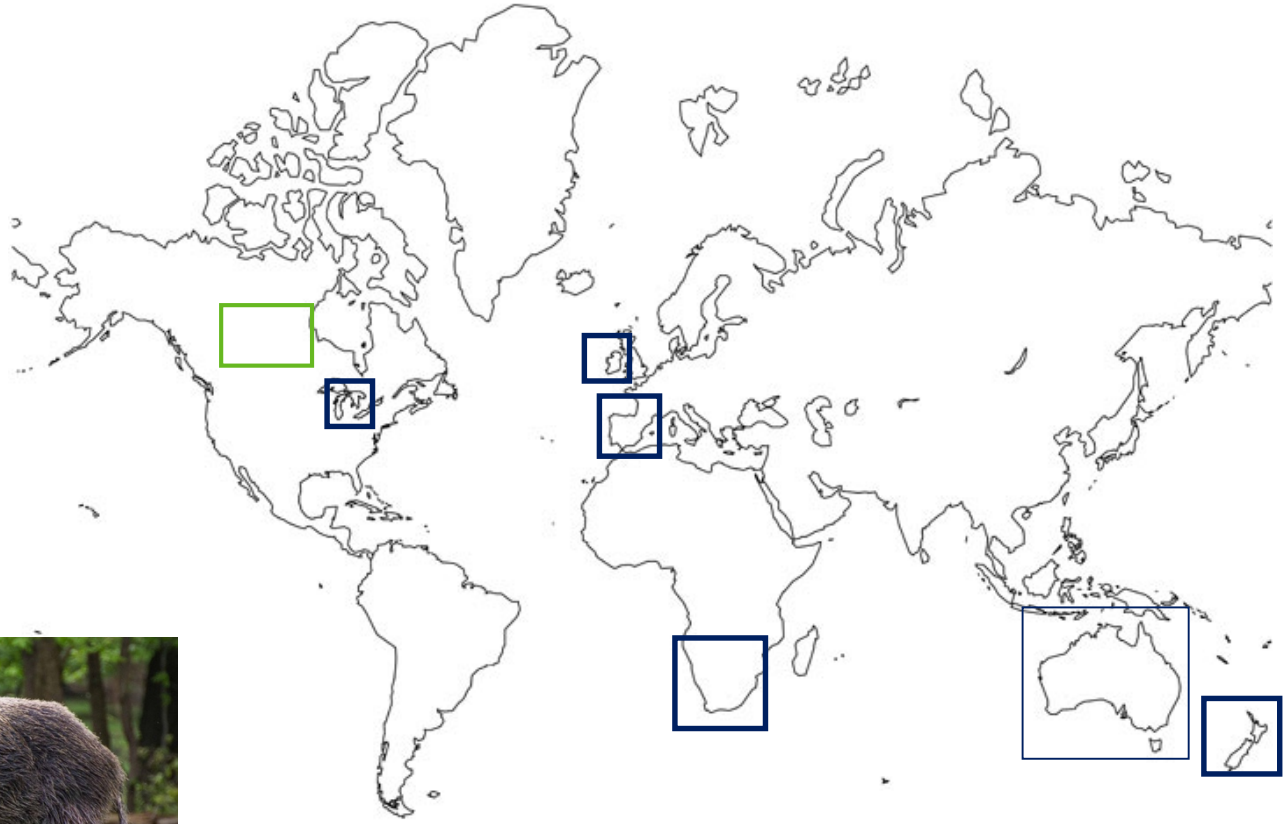


A maintenance/reservoir host
with spillover/back to cattle

Eurasian badger
(Meles meles)

A role for deer?





South Africa *(Kruger National Park)*

Lion (*Panthera leo)*

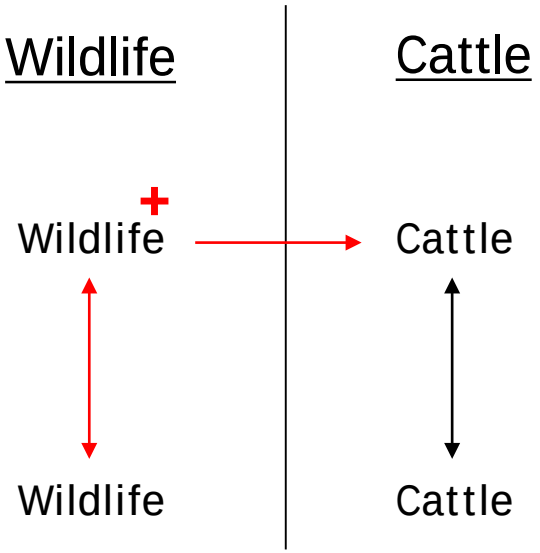
Maintenance hosts

- African buffalo
- Greater kudu
- Warthog

Spillover hosts

- Lion
- Leopard
- Cheetah
- Honey badger
- Chacma baboon
- Spotted hyena
- Large spotted genet
- Bushpig
- Impala
- Eland

Key challenges



Wildlife

- Limiting/preventing transmission from wildlife to cattle

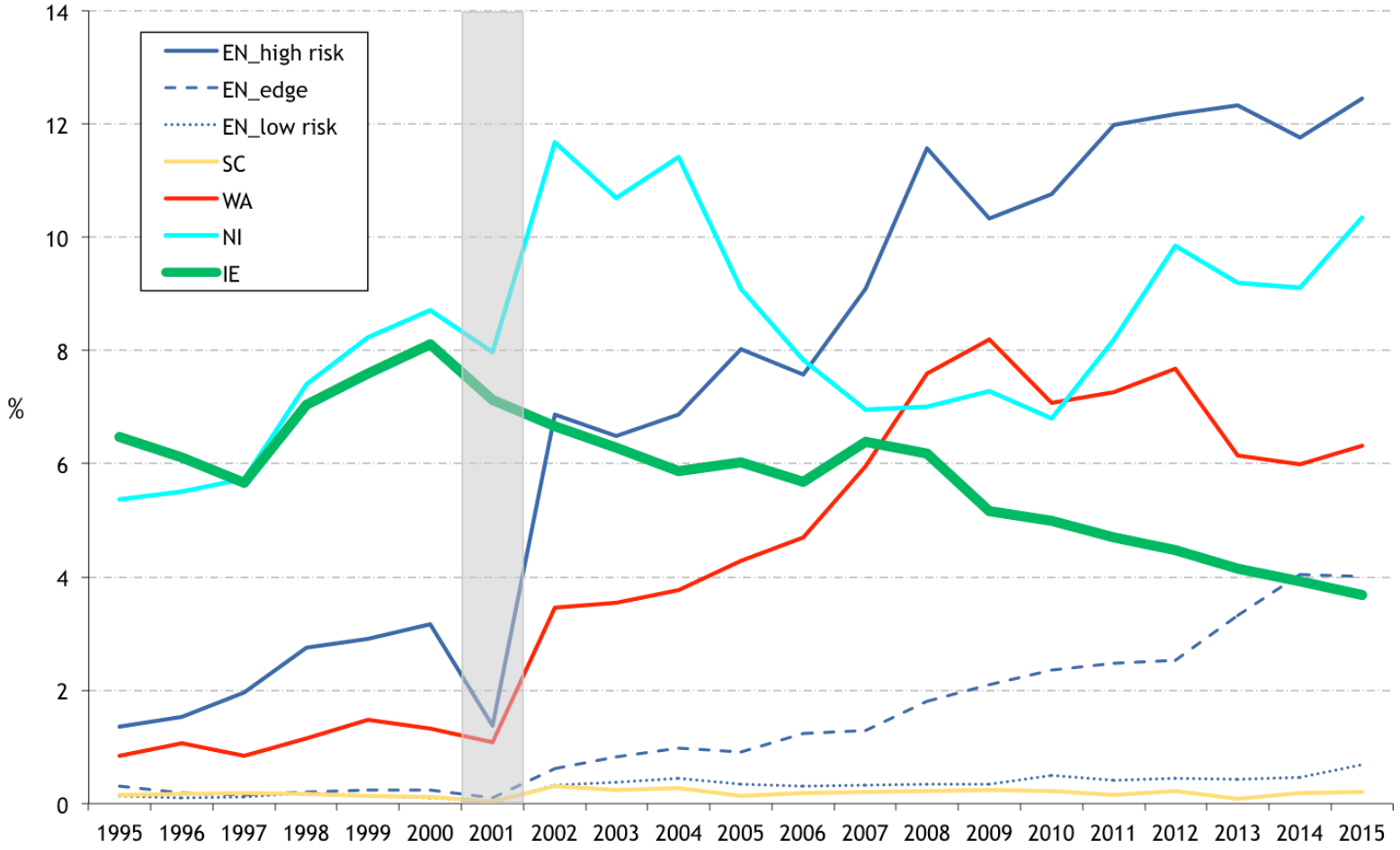
Cattle

- Clearing infected herds
  - Detecting all infected cattle *(ie 'residual infection')*
- Limiting herd-to-herd transmission

Programme governance

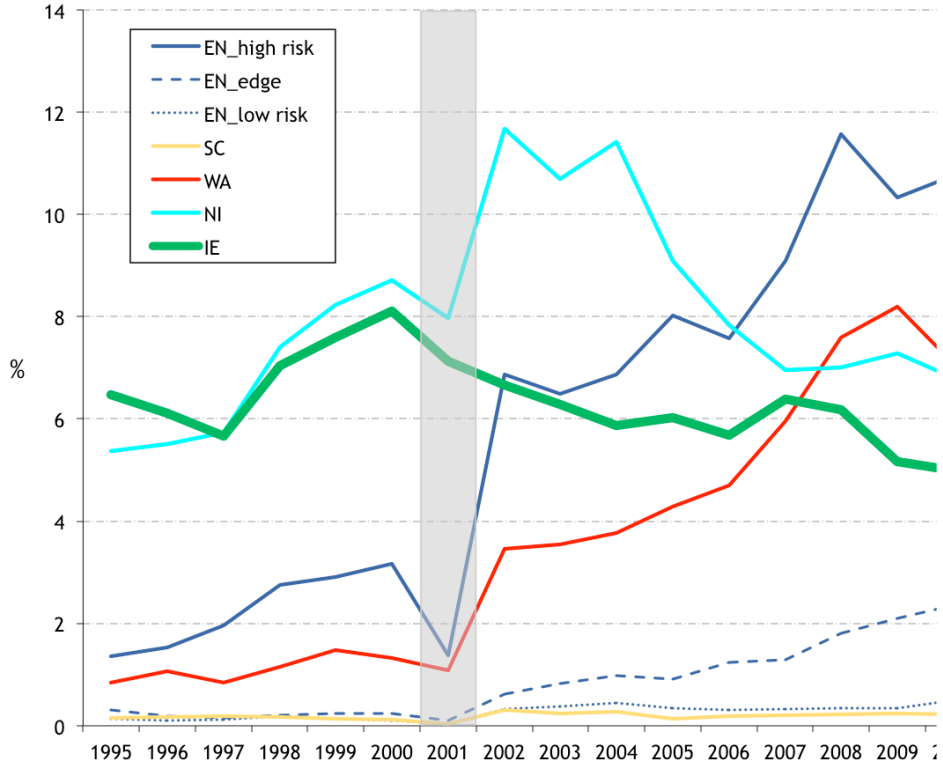
- Management
- Cost-sharing

3. ‘Wishful thinking’



Standardised annual herd incidence

More, S.J., Houtsma, E., Doyle, L., McGrath, G., Clegg, T.A., de la Rua-Domenech, R., Duignan, A., Blissit, M.J., Dunlop, M., Schroeder, P., Pike, R., Upton, P. Further evaluation of bovine tuberculosis trends in the UK and the Republic of Ireland, 2003-15. *Veterinary Record*, submitted



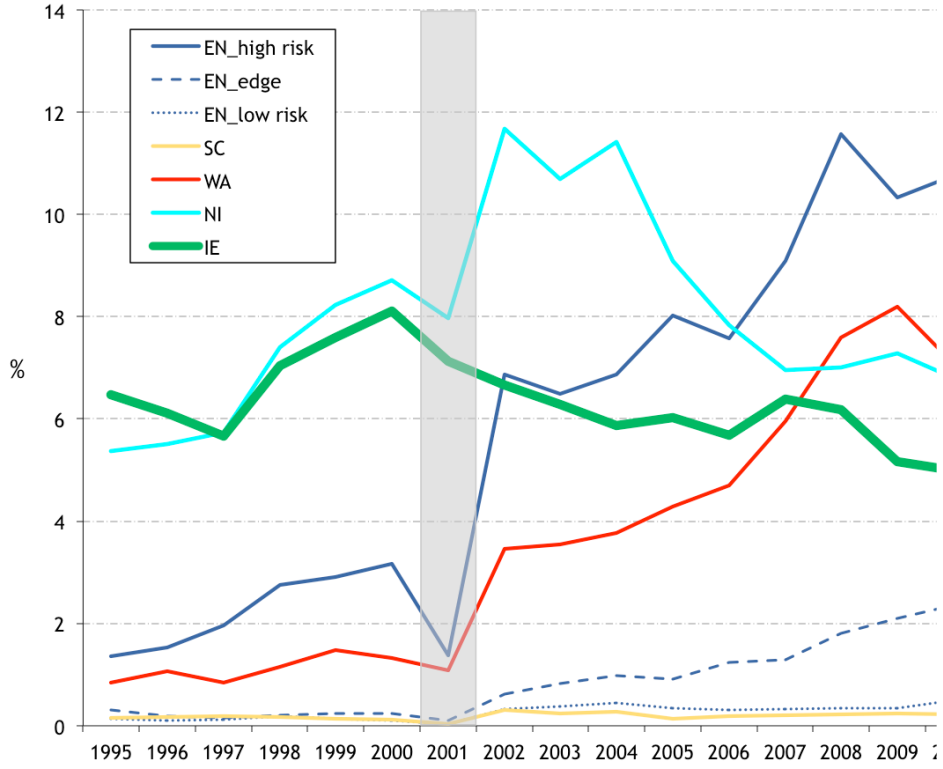
Standardised annual herd incidence

Wildlife

- Limiting/preventing transmission from wildlife to cattle

Potential options

- *Limiting contact*
  - Culling
  - Biosecurity
- *Dampening infection*
  - Vaccination



Standardised annual herd incidence

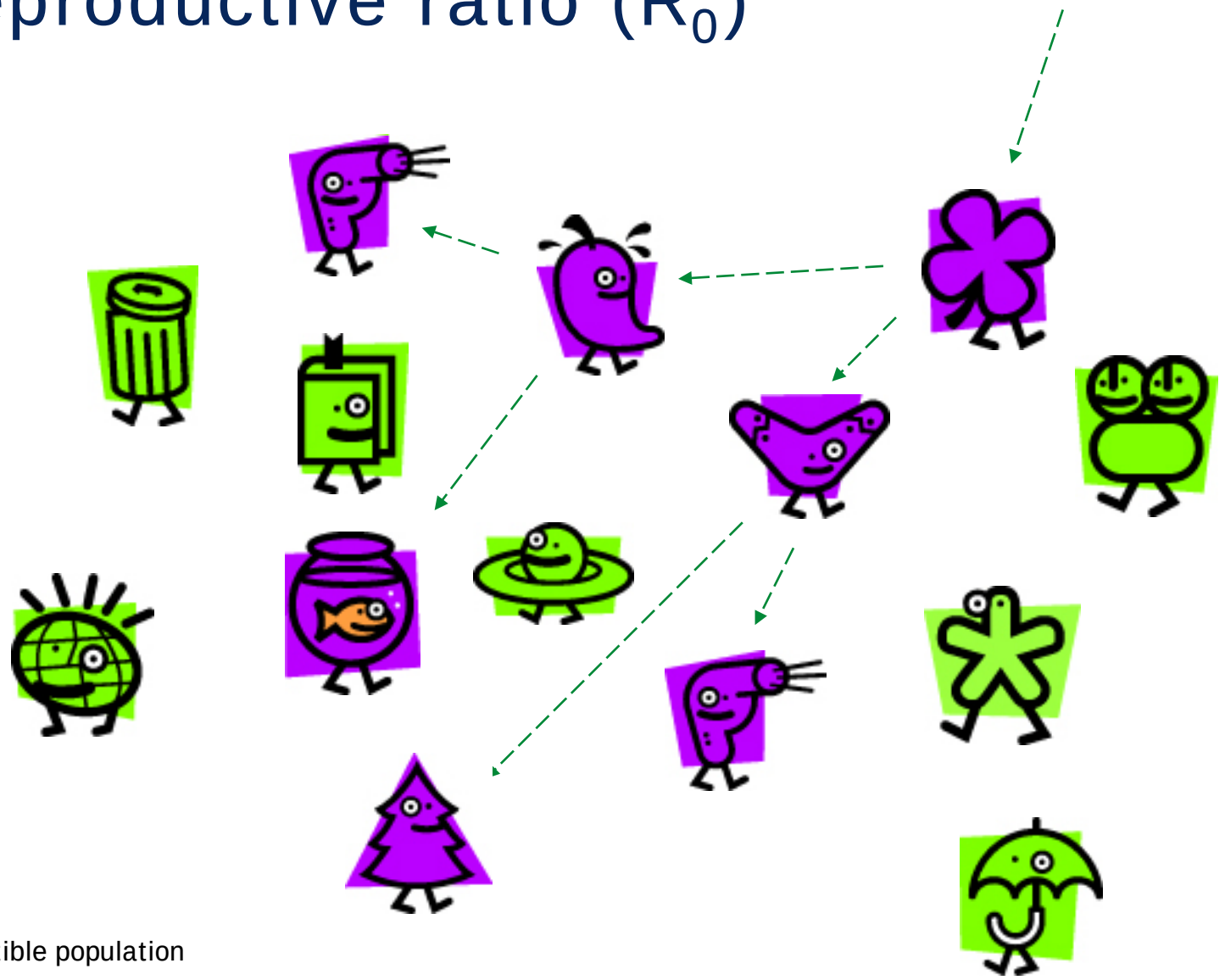
Cattle

- Clearing infected herds
  - Detecting all infected cattle *(ie 'residual infection')*
- Limiting herd-to-herd transmission

Challenges

- Imperfect tests
- Ongoing (substantial) movement

Basic reproductive ratio (R_0)



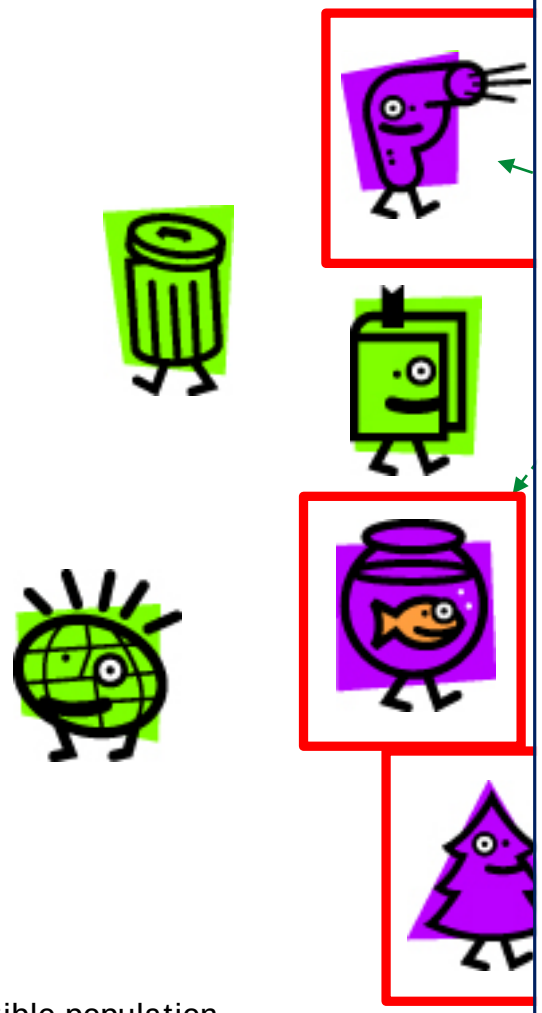
$R_0=2$

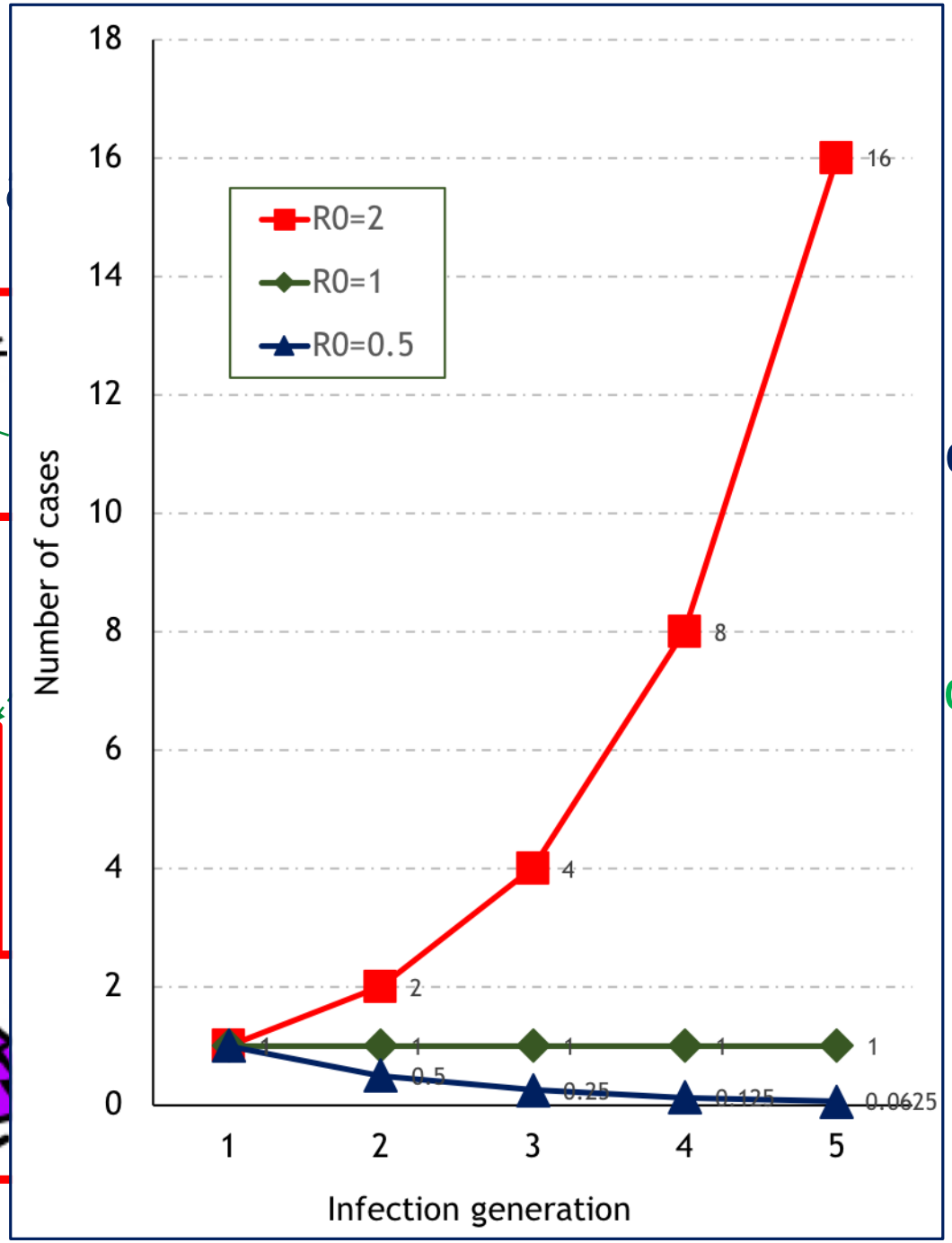
A fully-susceptible population

Basic reproductive r

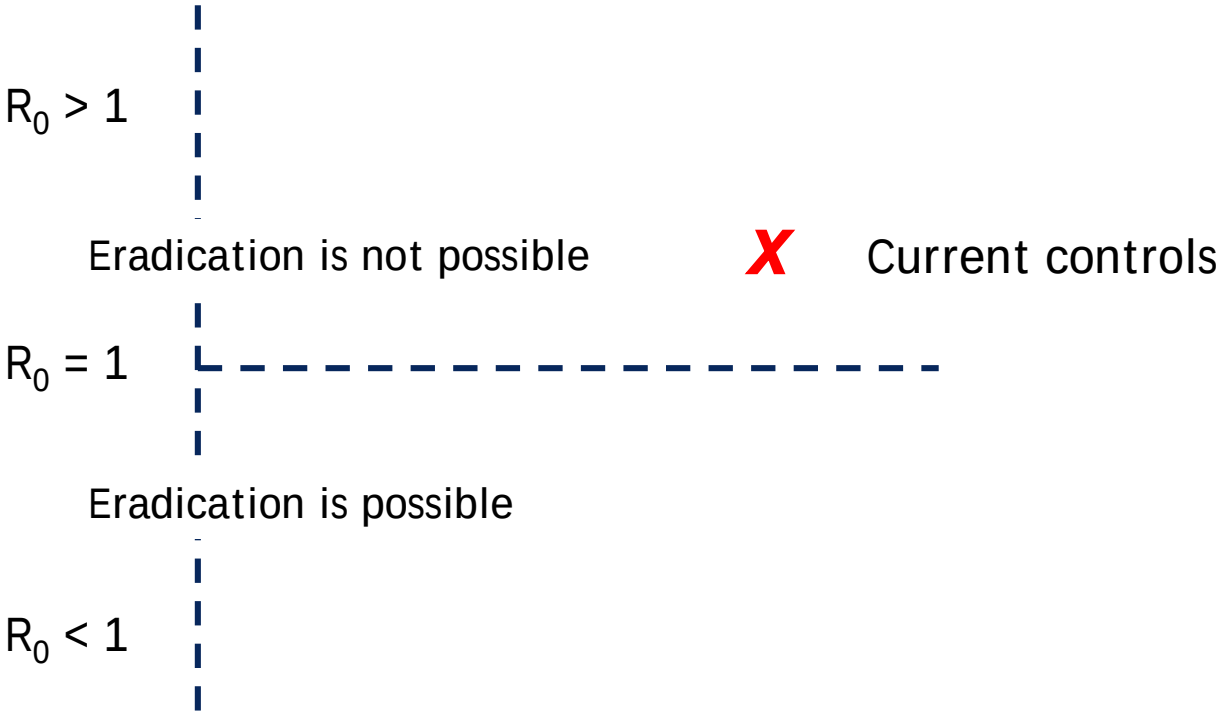
eration

on



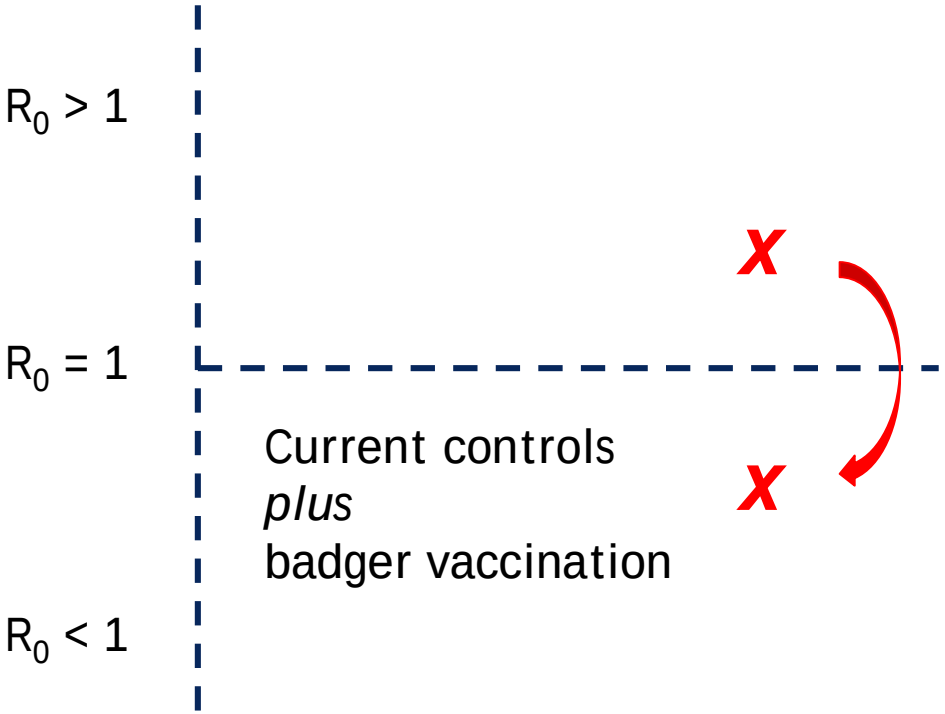


A fully-susceptible population



Aznar, I., Frankena, K., More, S.J., Clegg, T.A., McGrath, G., O'Keeffe, J., Byrne, A.W., de Jong, M.C.M. Characterizing transmission of *Mycobacterium bovis* in a multi-host system. *PNAS*, submitted

4. Substantial advance



Preventive Veterinary Medicine 149 (2018) 29–37

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Quantification of *Mycobacterium bovis* transmission in a badger vaccine field trial

I. Aznar[a,b,c,*], K. Frankena[b], S.J. More[a], J. O'Keeffe[c], G. McGrath[a], M.C.M de Jong[b]

[a] UCD Centre for Veterinary Epidemiology and Risk Analysis, UCD School of Veterinary Medicine, University College Dublin, Belfield, Dublin 4, Ireland
[b] Quantitative Veterinary Epidemiology group, Wageningen Institute of Animal Sciences, Wageningen University & Research, P.O. Box 338, 6700 AH Wageningen, The Netherlands
[c] Department of Agriculture, Food and the Marine, Kildare St., Dublin 2, Ireland

PLOS ONE

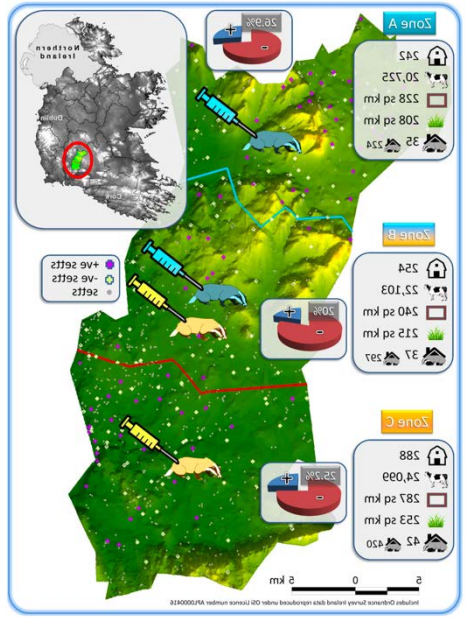
RESEARCH ARTICLE

Oral Vaccination of Free-Living Badgers (*Meles meles*) with Bacille Calmette Guérin (BCG) Vaccine Confers Protection against Tuberculosis

Eamonn Gormley[1]*, Deirdre Ní Bhuachalla[1], James O'Keeffe[2], Denise Murphy[1], Frank E. Aldwell[3], Tara Fitzsimons[1], Paul Stanley[1], Jamie A. Tratalos[4], Guy McGrath[4], Naomi Fogarty[5], Kevin Kenny[5], Simon J. More[4], Locksley L. McV. Messam[1], Leigh A. L. Corner[1]

1 School of Veterinary Medicine, University College Dublin (UCD), Dublin, Ireland, **2** Dept of Agriculture, Food and the Marine, Head of Wildlife Unit, Agriculture House, Dublin, Ireland, **3** Immune Solutions Ltd, Centre for Innovation, University of Otago, Dunedin, New Zealand, **4** UCD Centre for Veterinary Epidemiology and Risk Analysis (CVERA), School of Veterinary Medicine, University College Dublin (UCD), Dublin, Ireland, **5** Central Veterinary Research Laboratory, Backweston, Co. Kildare, Ireland

Kilkenny vaccine trial
(2009-13)

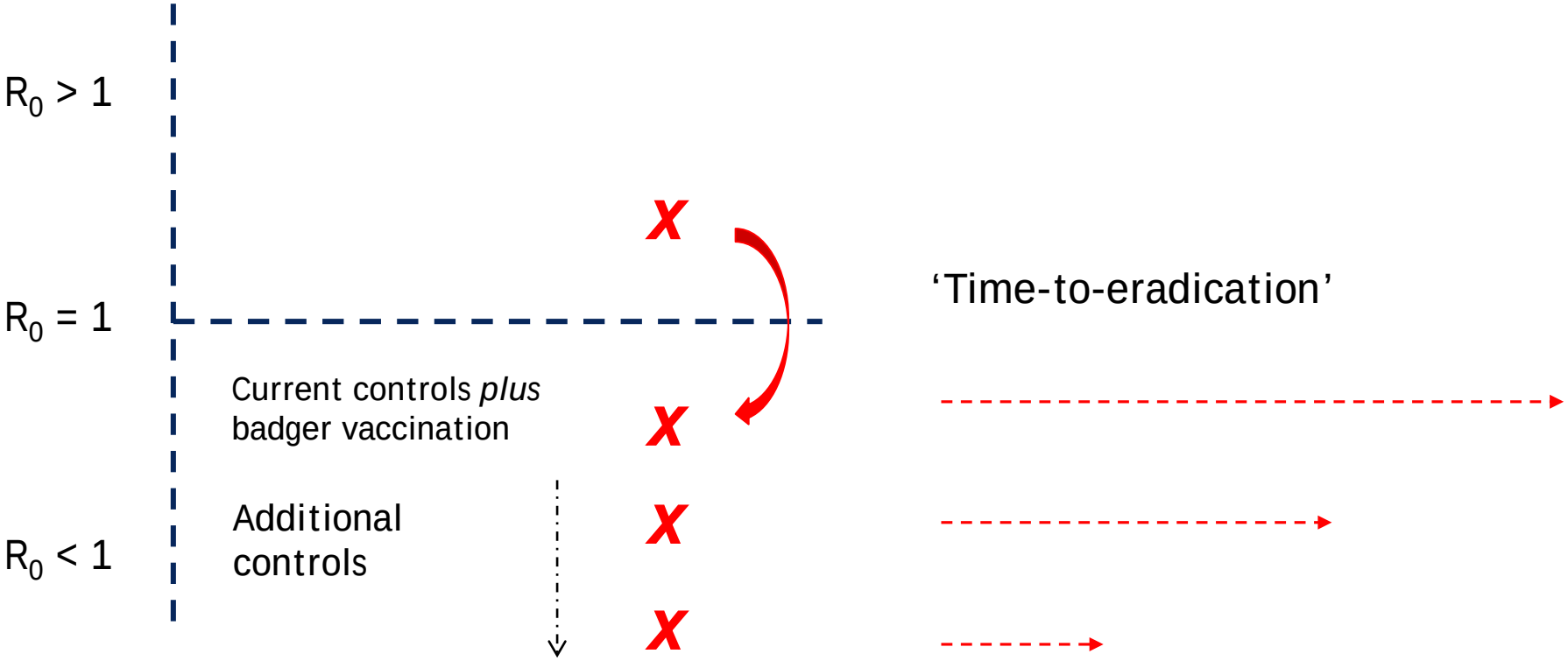


Aznar, I., Frankena, K., More, S.J., Clegg, T.A., McGrath, G., O'Keeffe, J., Byrne, A.W., de Jong, M.C.M. Characterizing transmission of *Mycobacterium bovis* in a multi-host system. *PNAS*, submitted

Aznar, I., Frankena, K., More, S.J., O'Keeffe, J., McGrath, G., De Jong, M.C.M., 2018. Quantification of *Mycobacterium bovis* transmission in a badger vaccine field trial. Prev Vet Med 149, 29–37. doi:10.1016/j.prevetmed.2017.10.010

Gormley, E., Bhuachalla, D.N., O'Keeffe, J., Murphy, D., Aldwell, F.E., Fitzsimons, T., Stanley, P., Tratalos, J.A., McGrath, G., Fogarty, N., Kenny, K., More, S.J., Messam, L.L.M., Corner, L.A.L., 2017. Oral vaccination of free-living badgers (Meles meles) with Bacille Calmette Guérin (BCG) vaccine confers protection against tuberculosis. PLoS One 12, e0168851. doi:10.1371/journal.pone.0168851

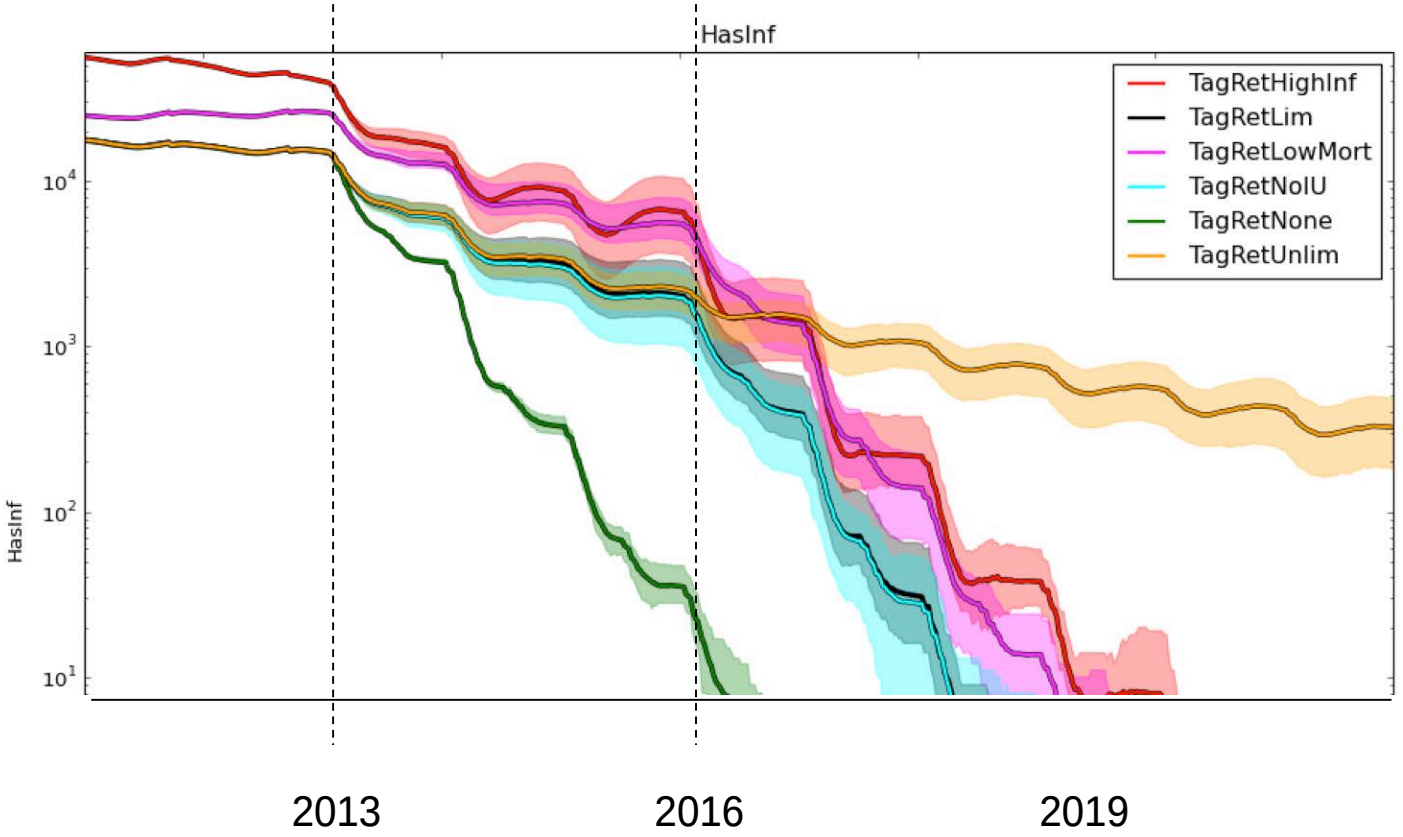
5. A critical decision point



Aznar, I., Frankena, K., More, S.J., Clegg, T.A., McGrath, G., O'Keeffe, J., Byrne, A.W., de Jong, M.C.M. Characterizing transmission of *Mycobacterium bovis* in a multi-host system. *PNAS*, submitted

BVD eradication

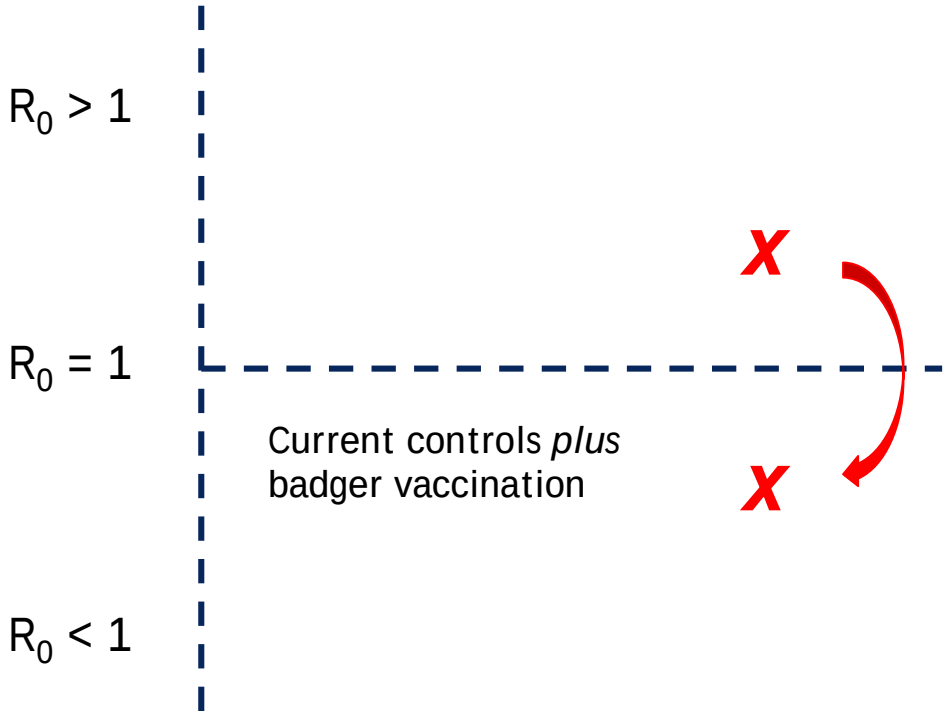
No. of PIs born annually



Thulke, H.-H., Lange, M., Tratalos, J.A., Clegg, T.A., McGrath, G., O'Grady, L., O'Sullivan, P., Doherty, M.L., Graham, D., More, S.J., 2018. Eradicating BVD, reviewing Irish programme data and model predictions to support prospective decision making. Prev Vet Med 150, 151–161. doi:10.1016/j.prevetmed.2017.11.017

6. Key challenges *(wildlife)*

Monitoring progress



Aznar, I., Frankena, K., More, S.J., Clegg, T.A., McGrath, G., O'Keeffe, J., Byrne, A.W., de Jong, M.C.M. Characterizing transmission of *Mycobacterium bovis* in a multi-host system. *PNAS*, submitted

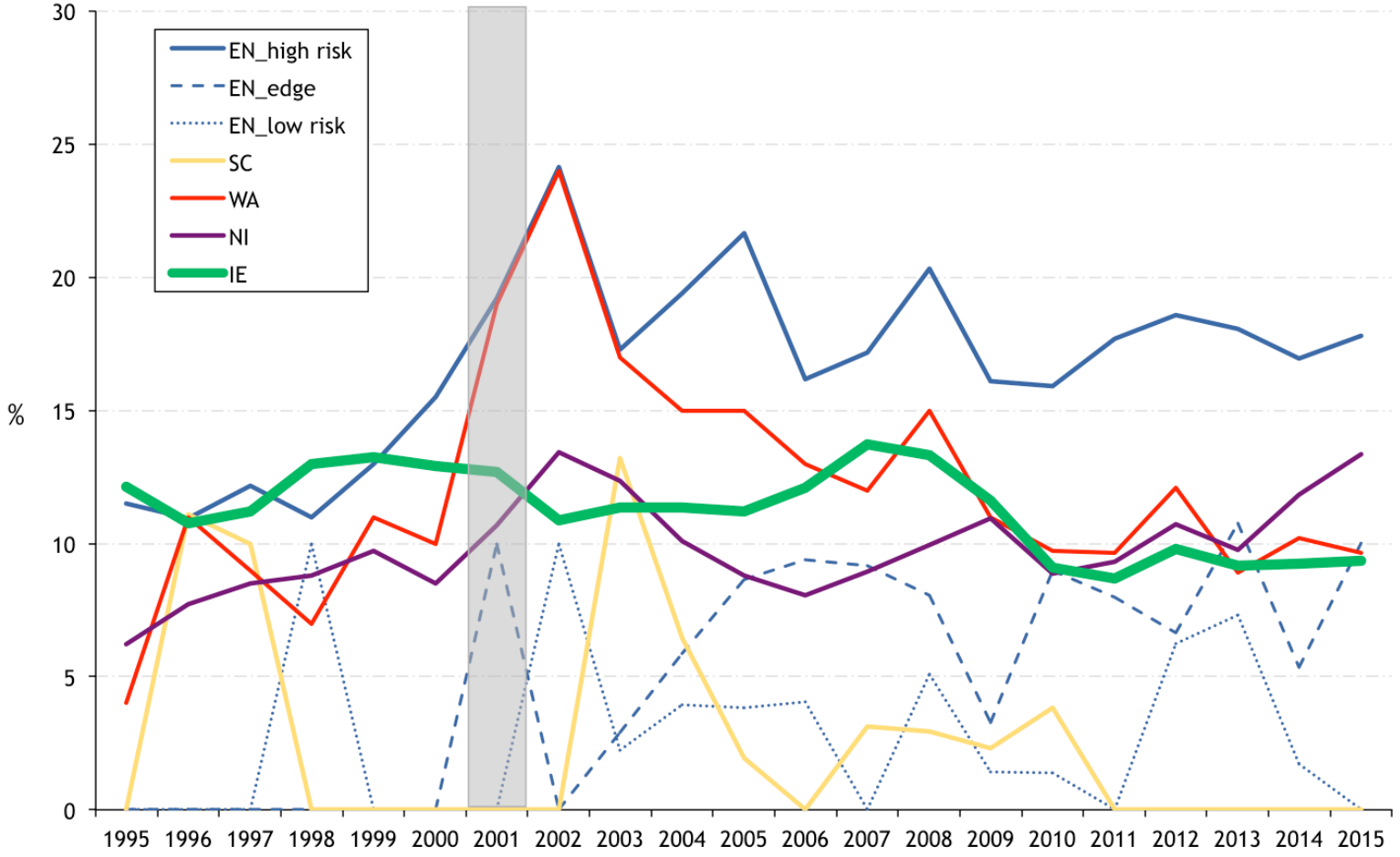
7. Key challenges *(cattle)*

The current focus in Ireland

- In
- Ra

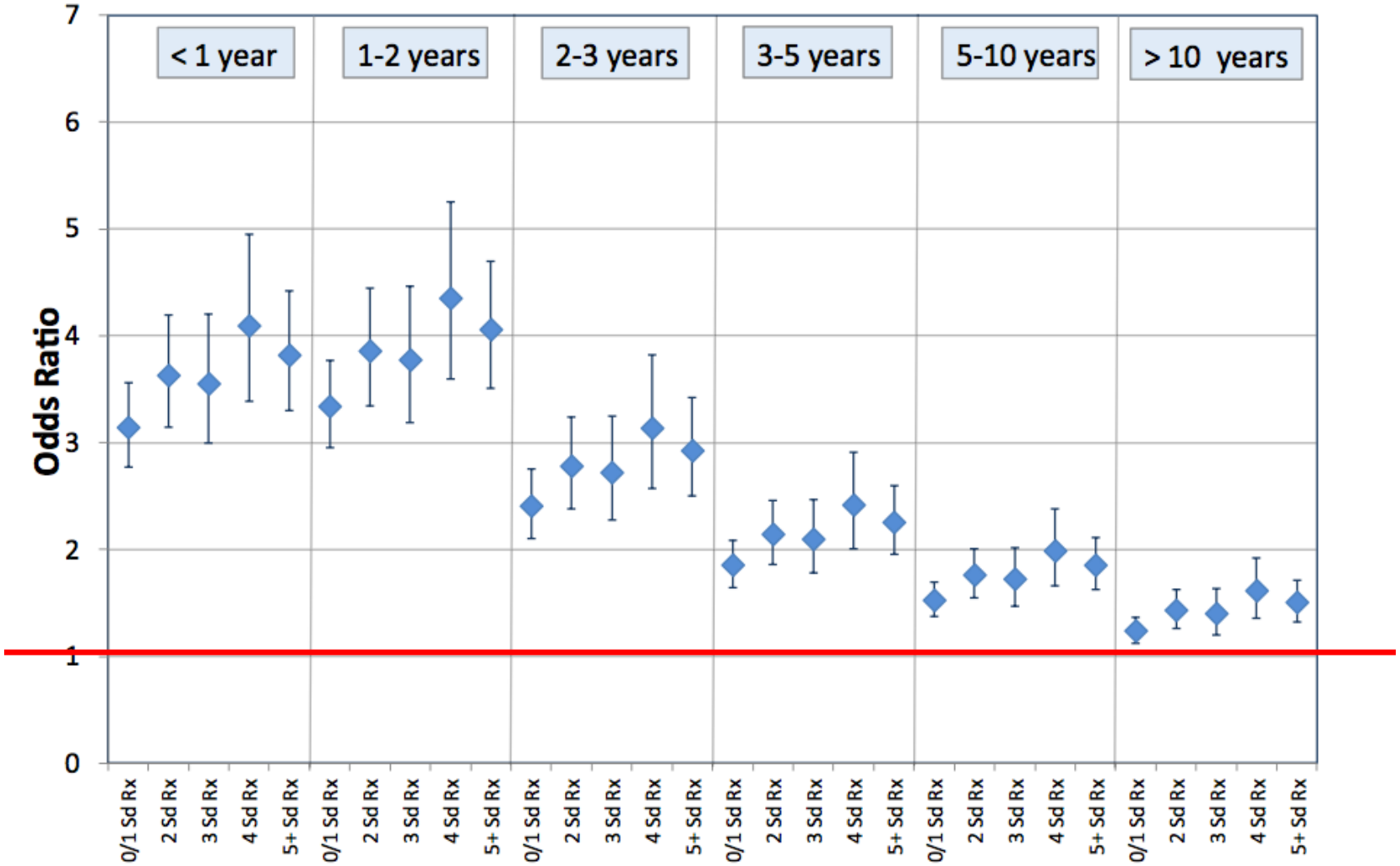
Some key challenges

- The disease
  - Residual infection
  - Prolonged *(variable)* period of heightened *(variable)* risk
- Programme objectives
  - A need to maximise test Se
- Diagnostic tests
  - Imperfect diagnostic tests *when conducted under ideal conditions*
    - Consistent interpretation is problematic (compliance, programme fatigue)
  - Additional diagnostic challenges as prevalence falls
- Commercial realities
  - A desire to minimise false +ves, reliance on 'lesion' confirmation
  - Very substantial animal movement
  - Variable biosecurity
  - The need for ongoing commerce throughout the programme
    - *(Early)* release of infected herds



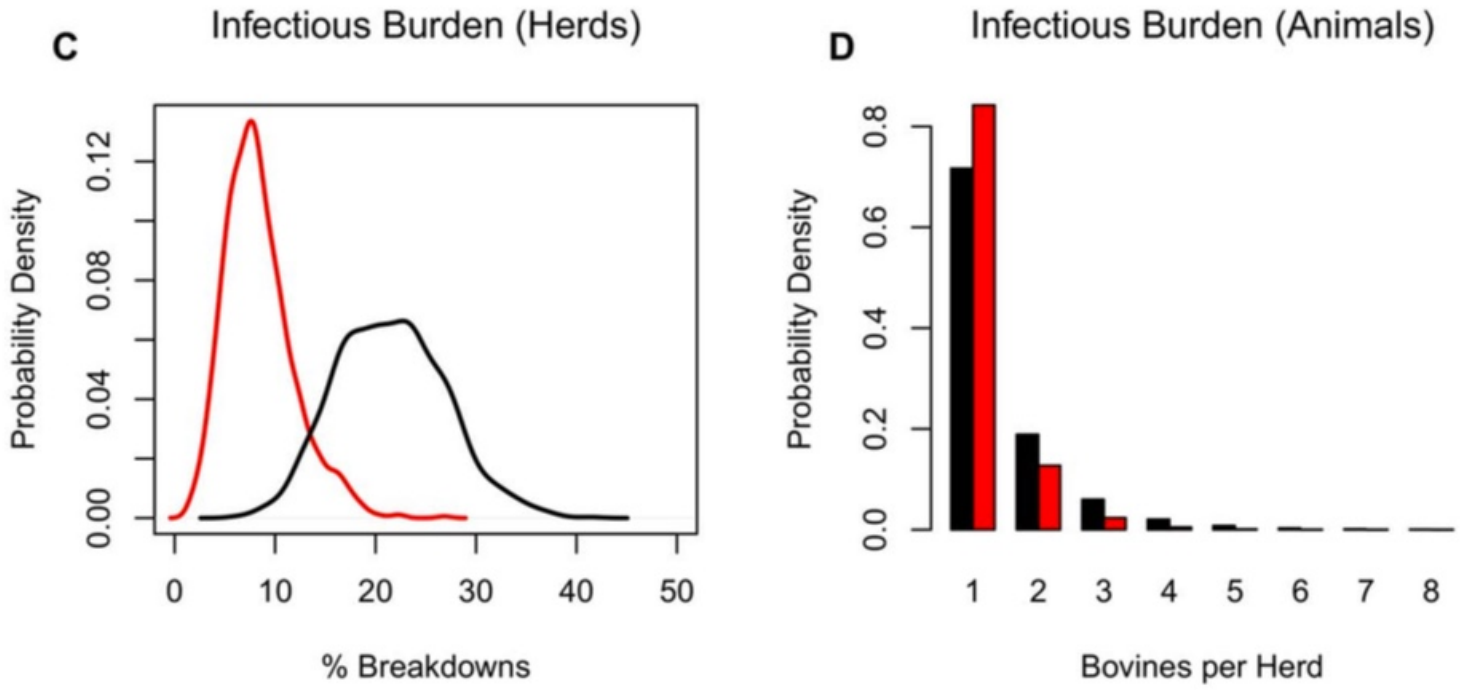
% failure at the 6 m post-derestriction test

More, S.J., Houtsma, E., Doyle, L., McGrath, G., Clegg, T.A., de la Rua-Domenech, R., Duignan, A., Blissit, M.J., Dunlop, M., Schroeder, P., Pike, R., Upton, P. Further evaluation of bovine tuberculosis trends in the UK and the Republic of Ireland, 2003-15. *Veterinary Record*, submitted



Future restriction risk, by previous history (severity, time)

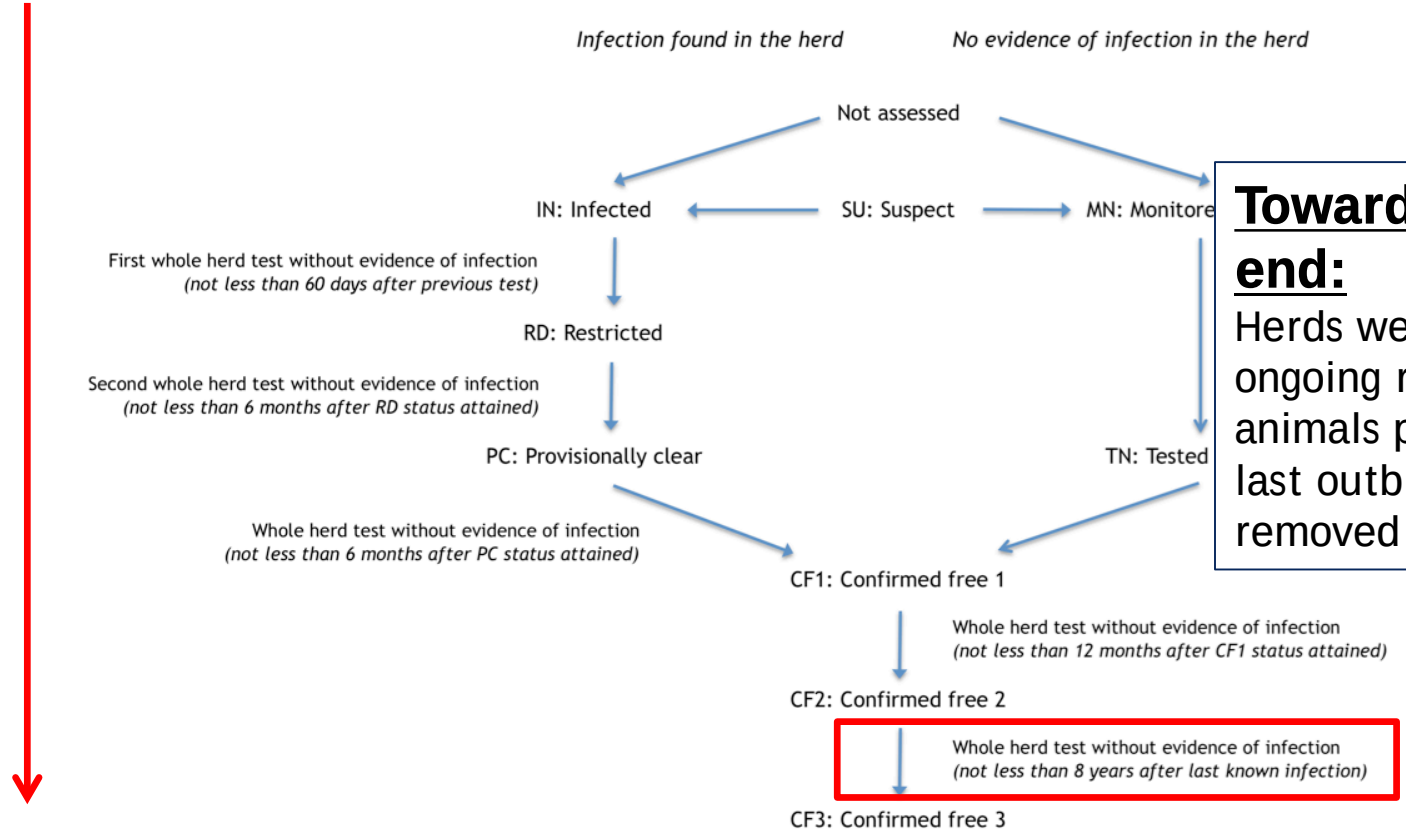
Clegg, T.A., Good, M., More, S.J., 2015. Future risk of bovine tuberculosis recurrence among higher risk herds in Ireland. *Preventive Veterinary Medicine* 118, 71–79. doi:10.1016/j.prevetmed.2014.11.013



% of breakdowns with at least 1 infected animal present at the time of derestriction. Of these, the estimated number of infected animals present

Conlan, A.J.K., McKinley, T.J., Karolemeas, K., Brooks-Pollock, E., Goodchild, A.V., Mitchell, A.P., Birch, C.P.D., Clifton-Hadley, R.S., Wood, J.L., 2012. Estimating the hidden burden of bovine tuberculosis in Great Britain. *PLoS Computational Biology* 8, e1002730. doi:10.1371/journal.pcbi.1002730

64/432 versus BTEC



Towards programme end:

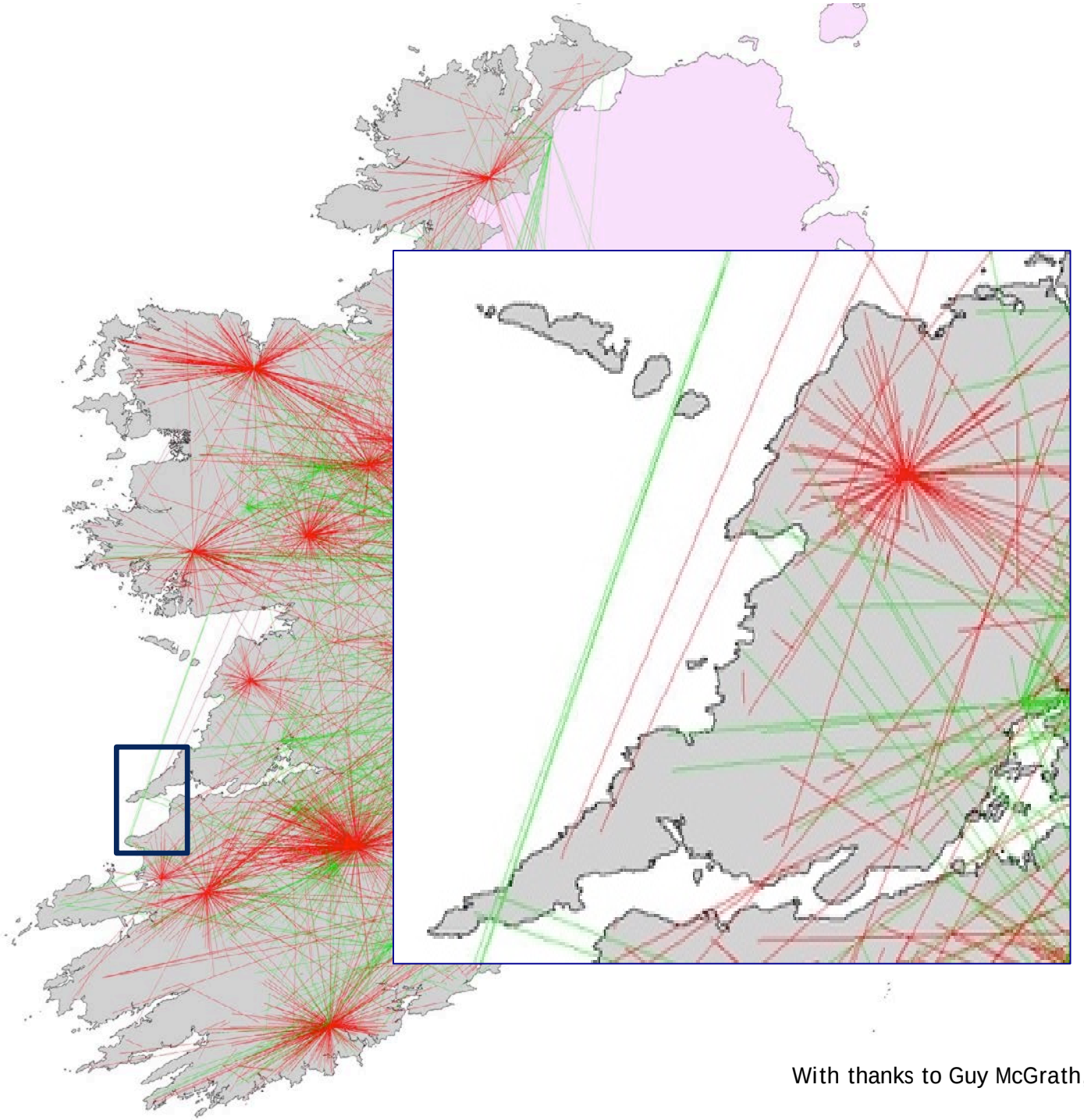
Herds were considered at ongoing risk until all animals present during the last outbreak had been removed

More, S.J., Radunz, B., Glanville, R.J., 2015. Lessons learned during the successful eradication of bovine tuberculosis from Australia. *Veterinary Record* 177, 224–232. doi:10.1136/vr.103163

10 October 2016
[ie one day]

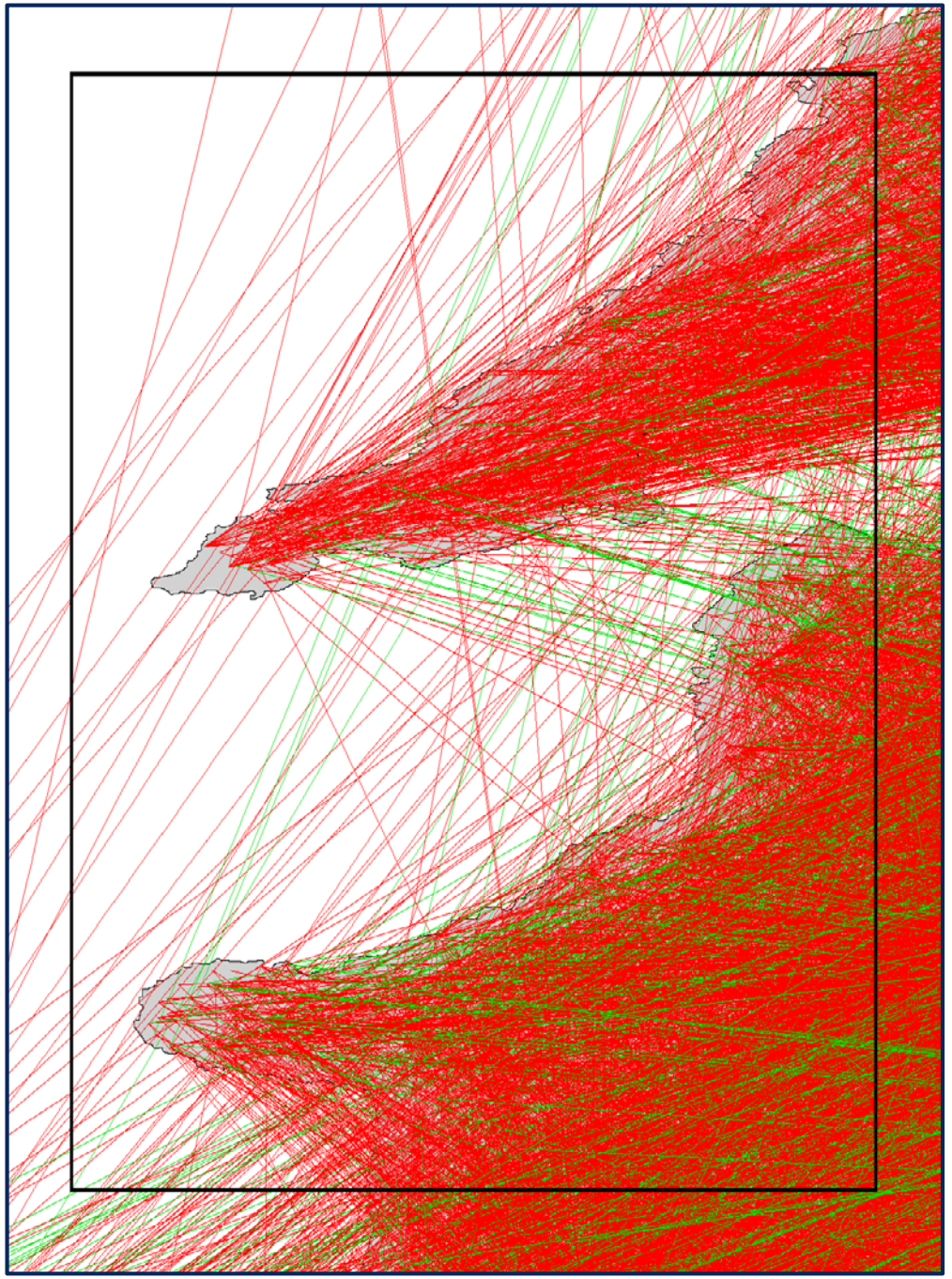
Red:
- Farm to mart
- Farm to farm
- Dealers

Green:
- Abattoir
- Knackery
- Export

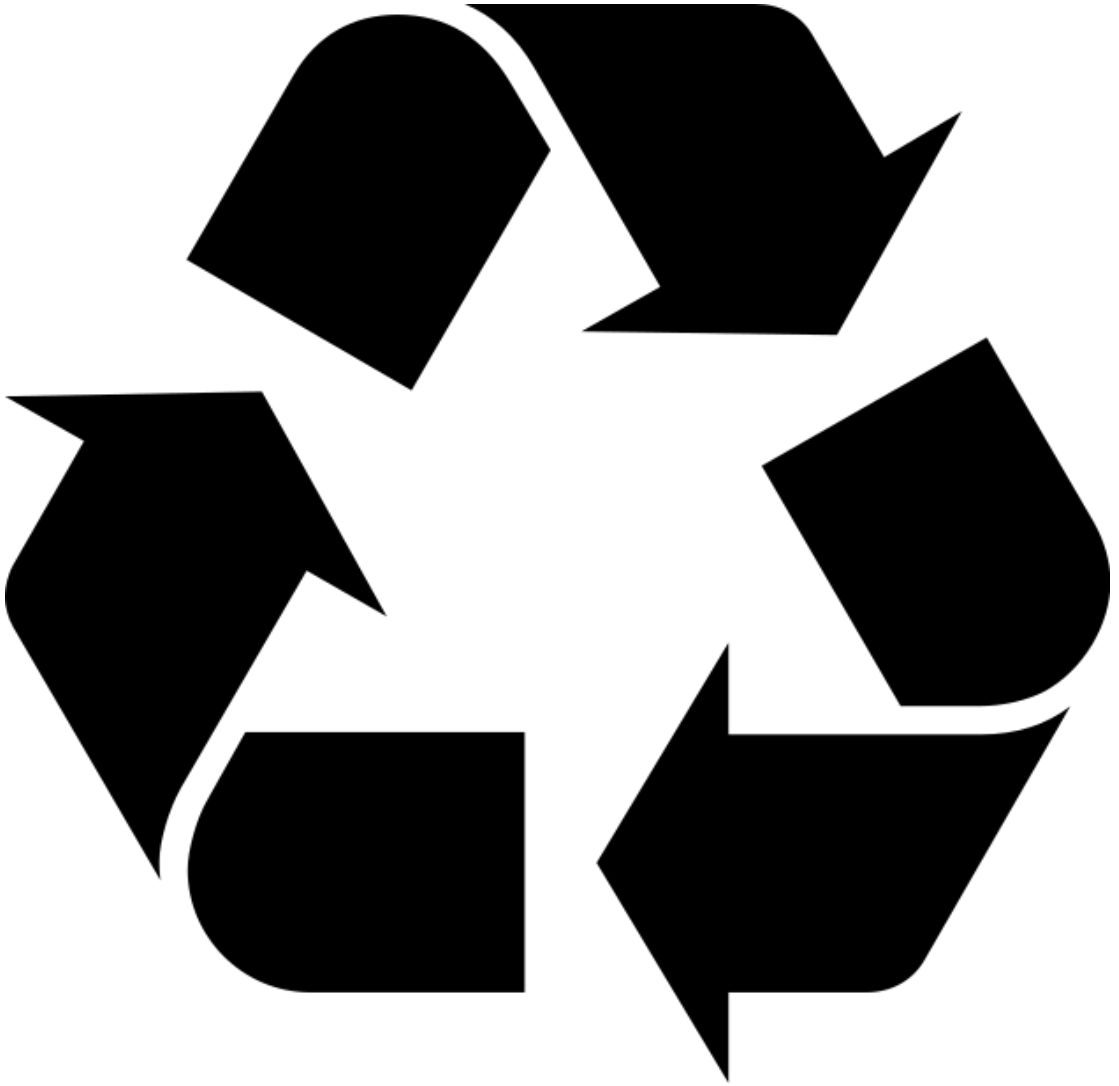


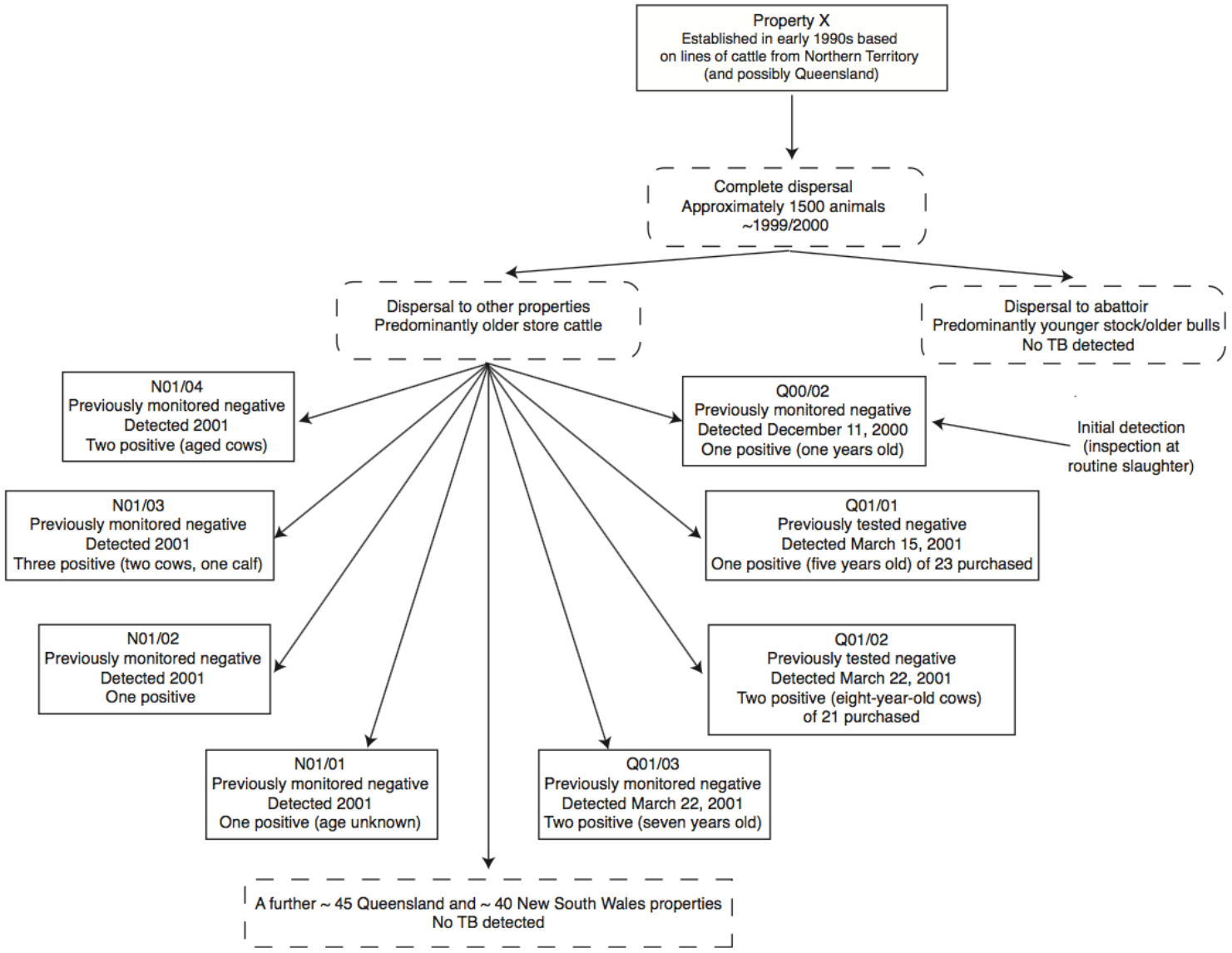
With thanks to Guy McGrath, CVERA

2016
[One year]



With thanks to Guy McGrath



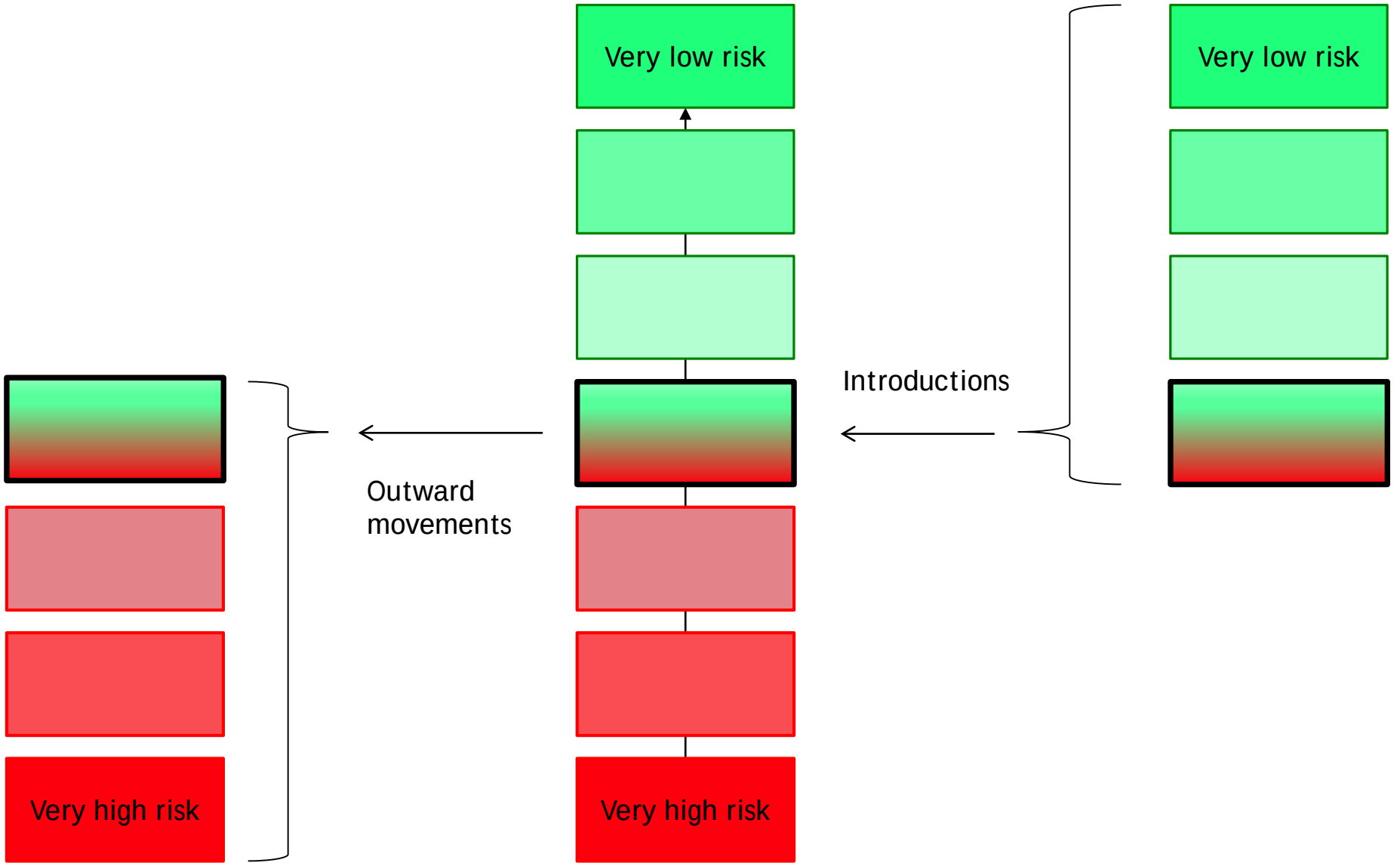


More, S.J., Radunz, B., Glanville, R.J., 2015. Lessons learned during the successful eradication of bovine tuberculosis from Australia. *Veterinary Record* 177, 224–232. doi:10.1136/vr.103163

The Australian approach

Only useful now ... *once transmission from wildlife has been resolved*

- Risk was assessed at the level of the herd, not the individual
- Risk-based herd (and area) classification was used
- Movement restrictions were determined on the basis of herd risk (*risk-based trading*)
- In infected herds, a range of strategies were used to manage residual infection
  - Controls progressively tightened as the programme progressed


Very low risk
Very low risk
Introductions
Outward
movements
Very high risk
Very high risk

8. Key challenges *(Programme governance)*

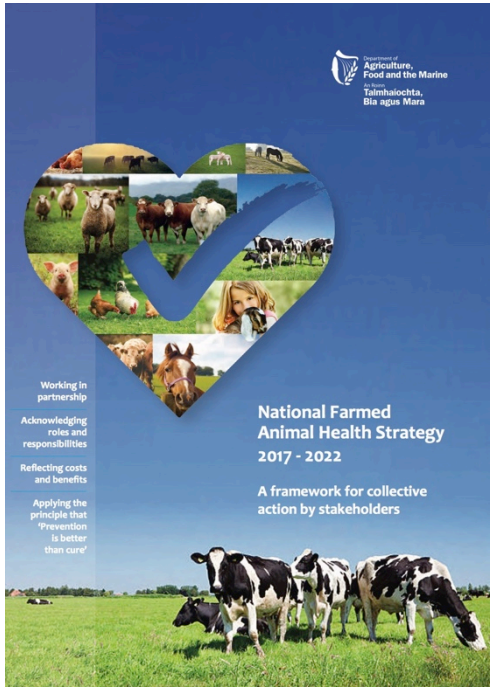
The current situation

- A government problem
- No burning platform
- A well-worn narrative
- A focus on the lowest common denominator
- Programme fatigue

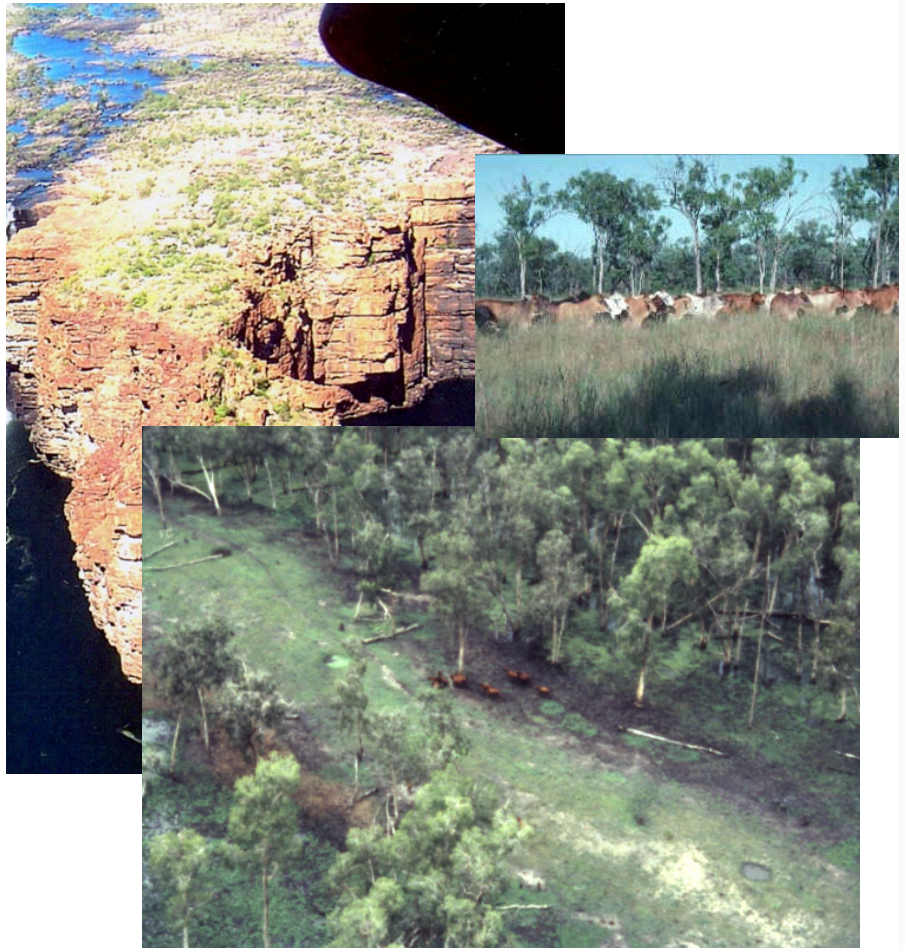
Irish Farmers Journal, 27 August 2005

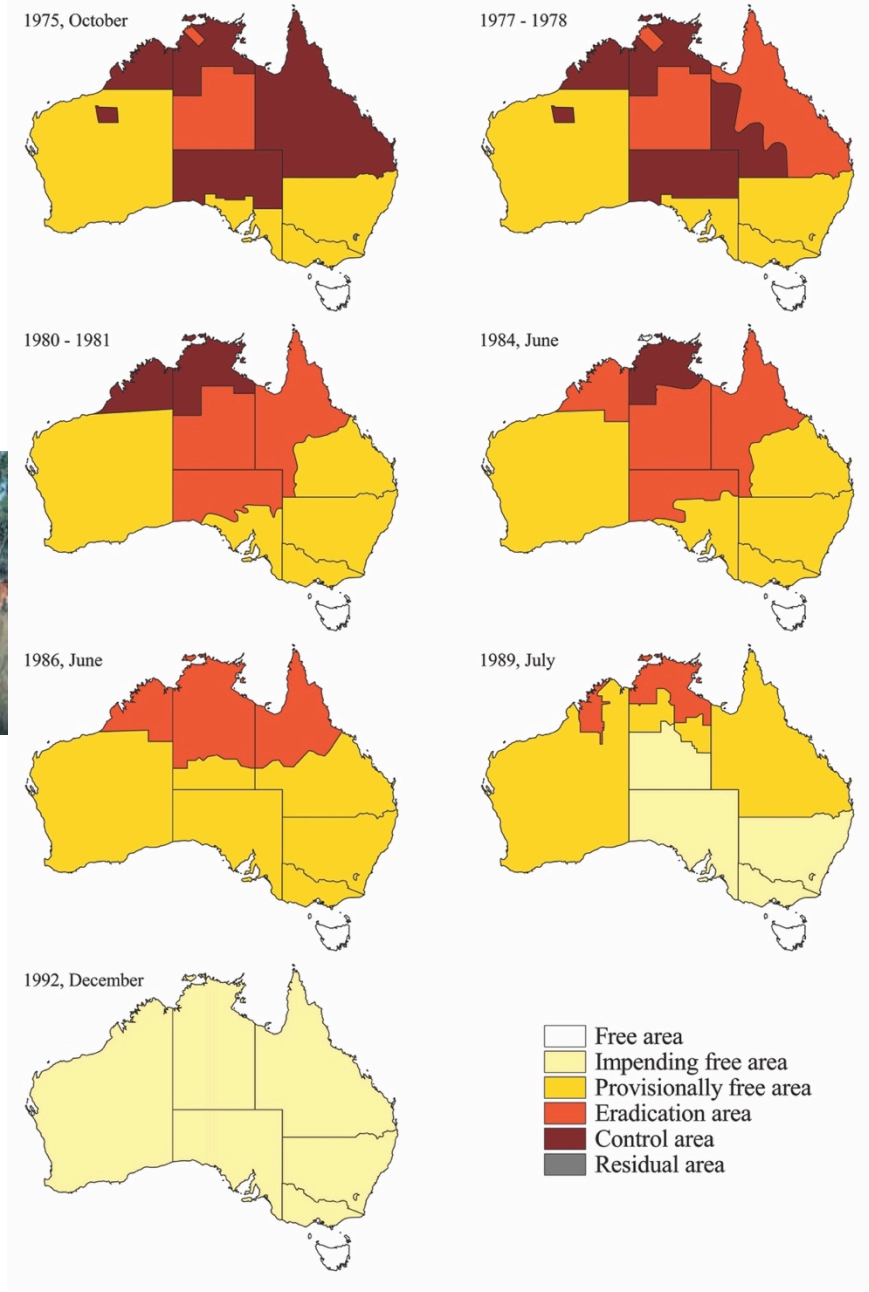
National Farmed Animal Health Strategy, 2017-22

- Working in partnership
- Acknowledging roles and responsibilities
- Reflecting costs and benefits



The Australian experience





More, S.J., Radunz, B., Glanville, R.J., 2015. Lessons learned during the successful eradication of bovine tuberculosis from Australia. *Veterinary Record* 177, 224–232. doi:10.1136/vr.103163

‘There had to be a better alternative to the drastic destocking measure that could ruin many graziers.’
Queensland Country Life, 21 June 1984

‘Cattlemen fear for their future as the bureacrats ride in. Right across northern Australia … there is a galloping sense of fear at the looming prospect of the destruction of the northern cattle industry’
Heather Brown, Weekend Australian, July 1984

‘We are the victims of bureacracy gone mad’
Tim Emmanuel, leading Kimberley pastoralist, 1984

Lehane, 1996. Beating the odds in a big country. CSIRO Publishing

A fundamental shift

The Australian business model

- Multi-annual strategic planning & annual operational plans
  - Long-term goals
  - Interim targets
  - Likely activities
  - Associated budgets
- Ongoing critical review of progress
- Legally binding contractual agreements (government, industry)

More, S.J., Radunz, B., Glanville, R.J., 2015. Lessons learned during the successful eradication of bovine tuberculosis from Australia. *Veterinary Record* 177, 224–232. doi:10.1136/vr.103163

Cost-sharing (Australia)

The beneficiary pays

TABLE 4: Cost-sharing arrangements as part of Australia's Emergency Animal Disease Response Agreement (Animal Health Australia 2001)

Category of emergency animal disease	Source of funding (per cent)	
	Government	Industry
Category 1: Public benefits only*	100	0
Category 2: Public benefits greater than private benefits†	80	20
Category 3: Proportion of public to private benefits is roughly equal‡	50	50
Category 4: Private benefits are greater than public benefits§ *[including bTB]*	20	80

There is no category where only private benefits exist. Cost-sharing applies in respect to salaries and wages, operating expenses, capital costs and compensation, but with some clarification. * Including Australian bat lyssavirus, rabies, † Including foot and mouth disease, sheep and goat pox, ‡ Including African swine fever, lumpy skin disease, § Including Aujeszky's disease, equine influenza

More, S.J., Radunz, B., Glanville, R.J., 2015. Lessons learned during the successful eradication of bovine tuberculosis from Australia. *Veterinary Record* 177, 224–232. doi:10.1136/vr.103163

Cost-sharing (New Zealand)

The beneficiaries and exacerbators pay

- Beneficiaries
  - The industry funds:
    - All livestock disease control activities
    - Some vector (wildlife) control activities
- Exacerbators
  - The government funds:
    - Some vector (wildlife) control activities

	Financial Year ending June					
	1985[a]	1991[b]	1995[c]	2000[d]	2005[e]	2010[f]
Income						
Central and local Government	4.3	5.9	11.2	26.0	36.0	34.1
Levies and Industry funding	3.3	13.5	21.5	26.2	45.3	44.9
Total	7.6	19.4	32.7	52.2	81.3	79.0
Industry share (%)	43	70	66	50	56	57
Expenditure						
Operational	Nd	2.2	1.4	3.6	6.0	6.3
Disease Control	4.7	8.1	11.7	14.5	17.7	18.4
Compensation	1.8	3.5	3.5	1.2	0.9	0.5
Research	0	0.5	1.8	2.5	2.6	2.5
Vector control	1.1	4.1	14.3	30.4	54.1	51.3
Total	7.6	18.4	32.7	52.2	81.3	79.0

Livingstone, P., Hancox, N., Nugent, G., Mackereth, G., Hutchings, S.A., 2015. Development of the New Zealand strategy for local eradication of tuberculosis from wildlife and livestock. *New Zealand Veterinary Journal* 63 Suppl 1, 98–107. doi:10.1080/00480169.2015.1013581

Governance

- Ownership
- Strategic planning
- Decision-making

Cost-sharing

9. Lessons from BTEC, Australia

Research

Review

OPEN ACCESS

Lessons learned during the successful eradication of bovine tuberculosis from Australia

S. J. More, B. Radunz, R. J. Glanville

Veterinary Record (2015), 224-232 doi: 10.1136/vr.103163

Key lessons learned

- A compelling rationale, both nationally and for individual farmers
- Industry commitment and support
  - Genuine industry commitment
  - Cost-sharing by government and industry
- A business model for programme planning, implementation and review
- Consistent and transparent technical standards, underpinned by a strict regulatory regime, as well as applied research
- Critical role of abattoir surveillance
- Effective elimination of residual infection
- Objective and readily understood measures of progress

More, S.J., Radunz, B., Glanville, R.J., 2015. Lessons learned during the successful eradication of bovine tuberculosis from Australia. *Veterinary Record* 177, 224–232. doi:10.1136/vr.103163

More, S.J., Radunz, B., Glanville, R.J., 2015. Lessons learned during the successful eradication of bovine tuberculosis from Australia. *Veterinary Record* 177, 224–232. doi:10.1136/vr.103163