Australian Government

Department of Agriculture, Fisheries and Forestry

Simulating HPAI spread between flocks using AISPREAD

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Introduction

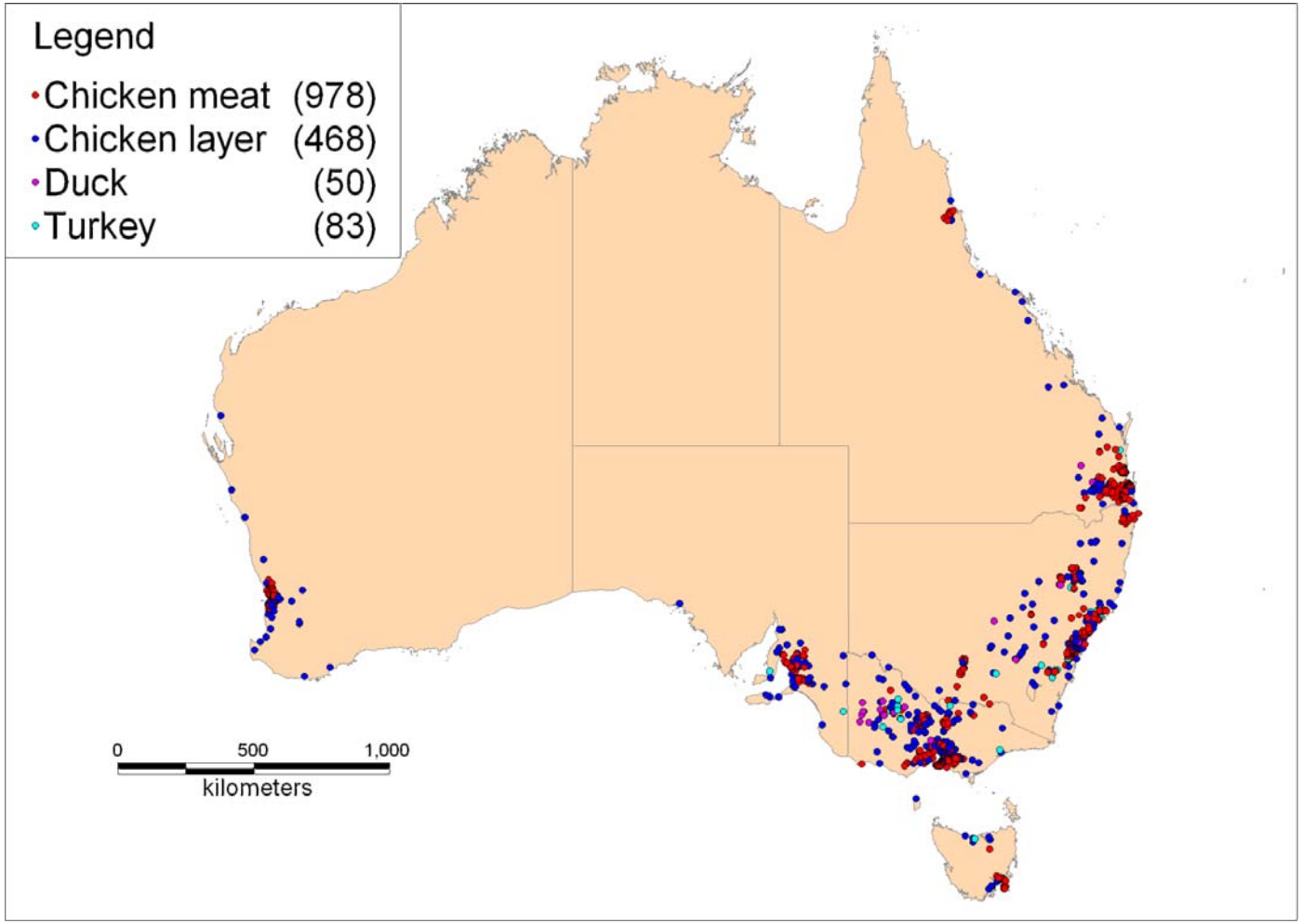
- Over the last decade, HPAI has become a major animal and public health issue
- Australia has experienced 5 epidemics of HPAI in low poultry density regions
- Uncertainty about how infection might spread in higher poultry density regions
- AISPREAD is a validated epidemiological simulation model for HPAI

Methods: Design of the model

- Commercial chicken meat, layer, duck and turkey farms
- Farms represented individually
- Stochastic (Incorporates chance)
- Spatial - points

- 4 modules
  - Production system module
  - Disease module
  - Mitigations module
  - Economic module
- Model description available on request

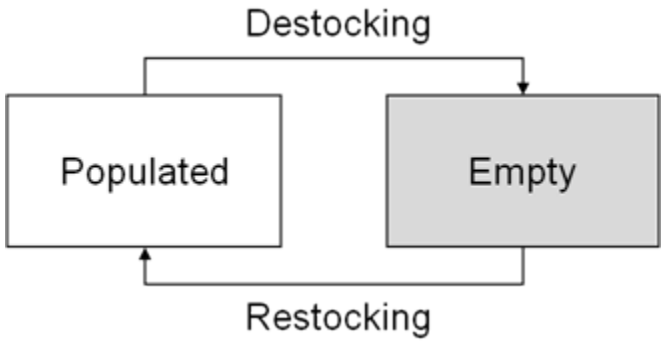
Study population



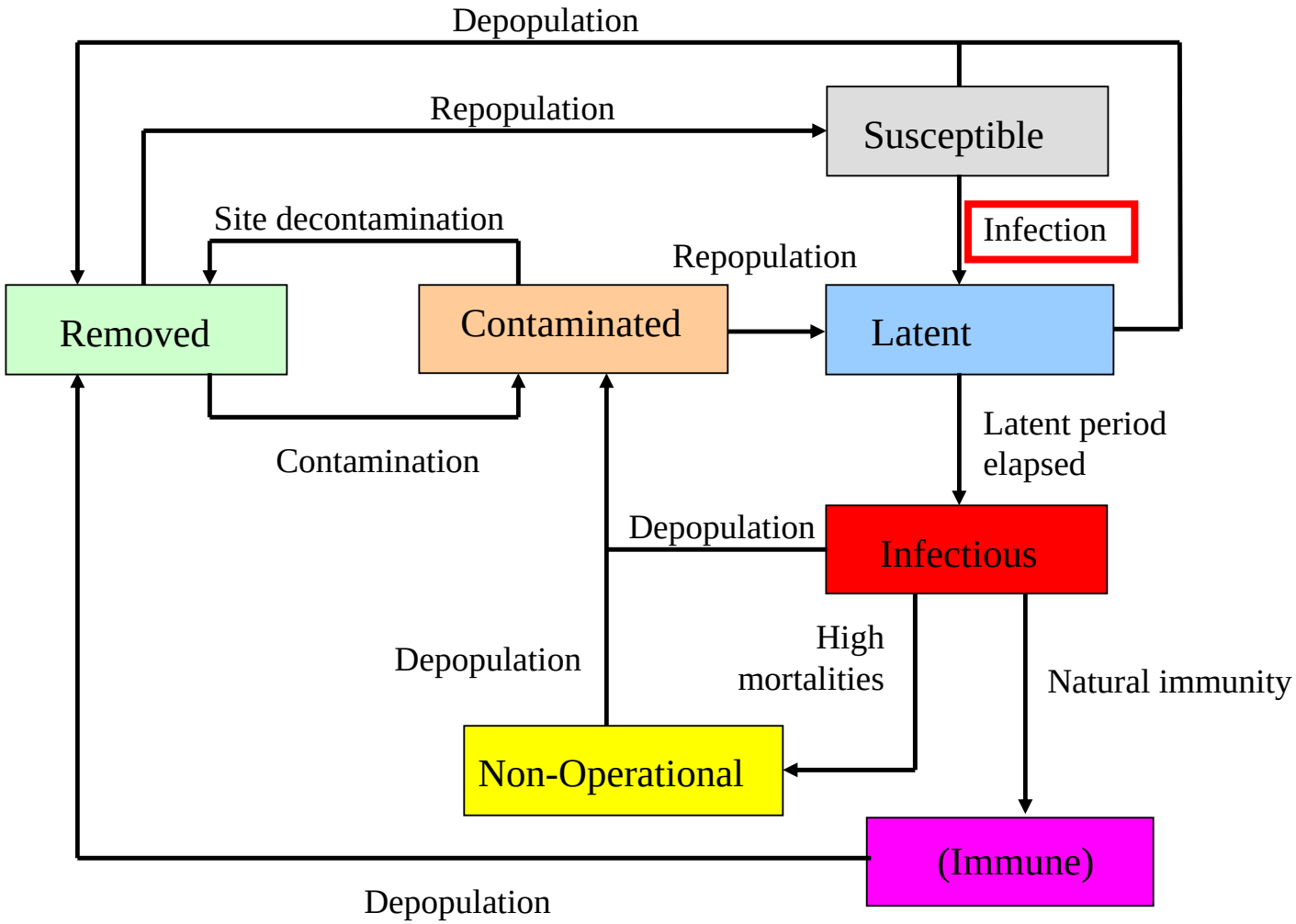
Production system module

- Poultry industries have complex dynamics
- 66% of farms in Australia single aged

- Includes timing of production events
  - Depopulation of single-aged farms
  - Chick/pullet deliveries
  - Service provider visits



Disease module



Disease transmission

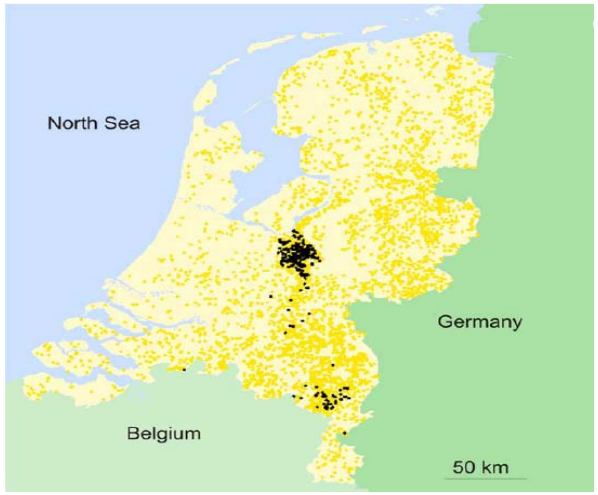
HPAI spreads by:

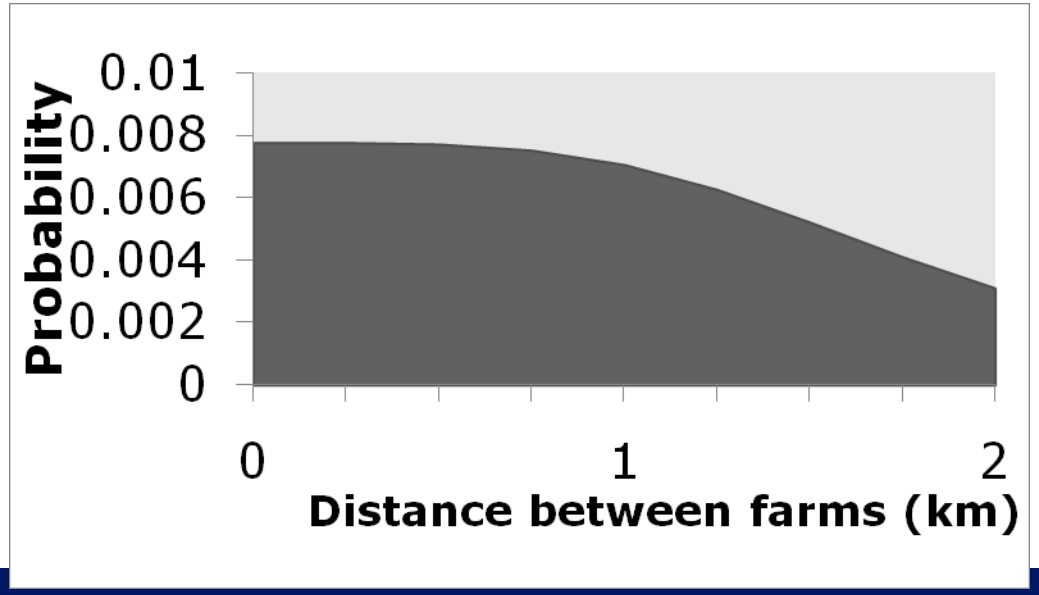
- “Local spread”
- Indirect contacts
  – i.e. contaminated objects (fomites)
- Movements of infected poultry

Local spread

- Potentially due to insects, airborne transmission, wild animals, unidentified contacts??

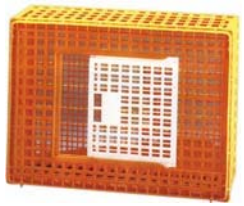
- Studied in 2003 H7N7 HPAI outbreak in the Netherlands (Boender et al., 2007)





Indirect contact pathways

1. Feed deliveries
2. Dead bird collection
3. Litter/manure removal
4. Chick delivery
5. Litter delivery
6. Sanitation crews
7. Reused cardboard egg trays
8. Vaccination crews
9. Other slaughter crews
10. Broiler pickup crews



Spread by indirect contacts

Infectious farm

Susceptible farm

Type of contact
Fomites:
- People
- Vehicles
- Equipment

• Biocontainment practices

• Biosecurity on fomite(s)
• Decay of virus
• Bioexclusion practices

Likelihood of spread by indirect contacts

- Survey of opinions of 10 poultry vets and scientists
- Presented with hypothetical transmission “scenarios” for layer/broiler farms (base transmission probability)
- Assessed the relative efficacy of biosecurity measures on different types of farms compared with layer farms (biosecurity factors)
- Report of expert opinion study available on request

Mitigations module

- Passive reporting of infection
- Zoning (RA & CA buffer areas)
- Quarantine & movement restrictions
- Active surveillance (dead bird pickup in RA and CA, visits, tracing)
- Culling
- Option for the accelerated slaughter for broilers (if test negative)
- (Emergency vaccination)

Economics module

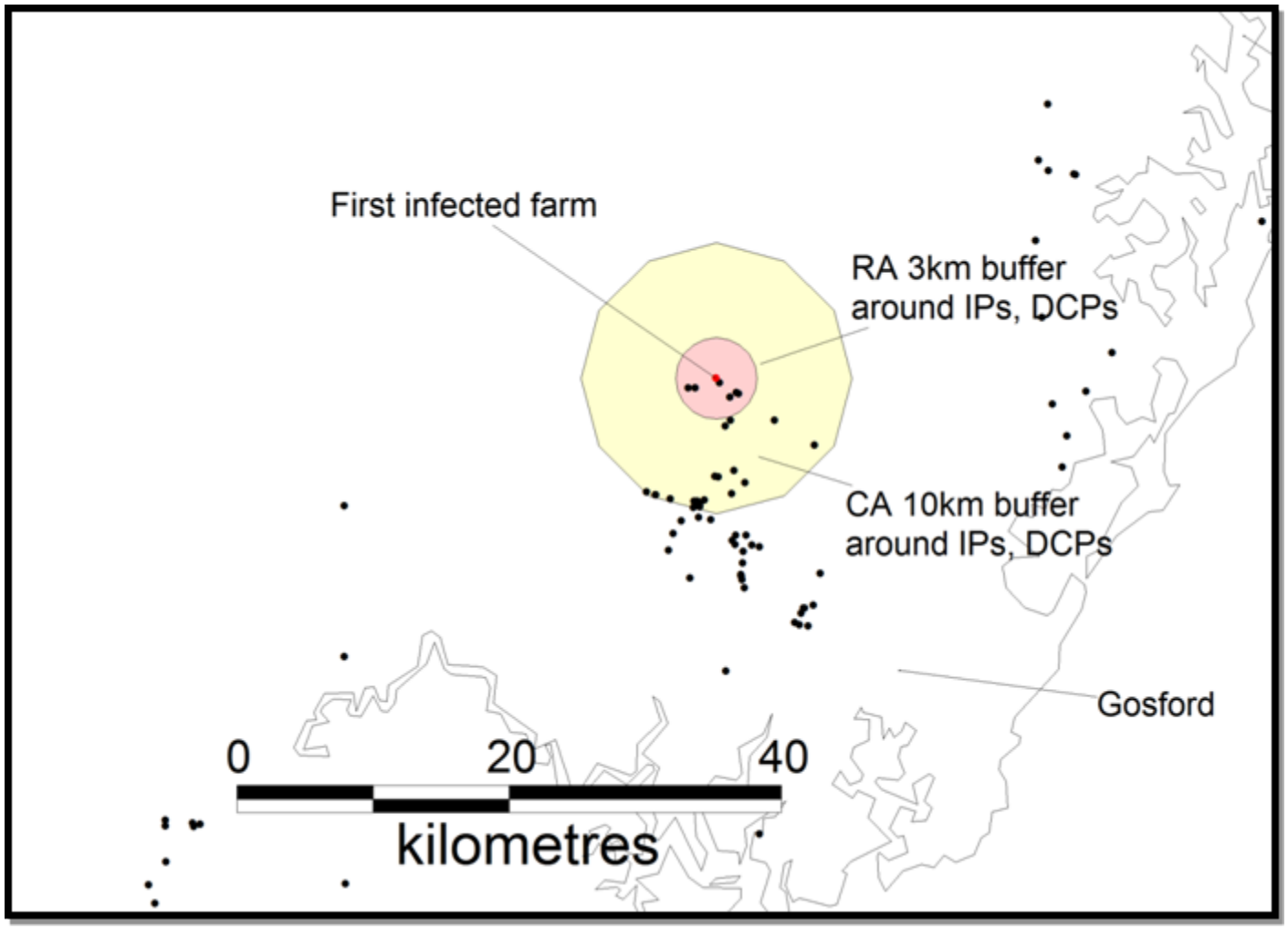
- Compensation ($2-$165 per head)
- Culling ($18,500 per shed)
- Decontamination ($4,200 per shed)
- Diagnostic testing ($34 per PCR, $6 per ELISA)
- Operational costs ($47,000 per infected state per day)
- Value of birds “overdue” for slaughter ($2-$165 per head)

Study objectives

- Investigate potential consequences of HPAI if introduced Central Coast NSW under three different control strategies
- Consequences measured by:
  - Number of infected farms
  - Epidemic duration
  - Number of dead/destroyed birds
  - Spatial extent of infection
  - Benefits/costs of each strategy

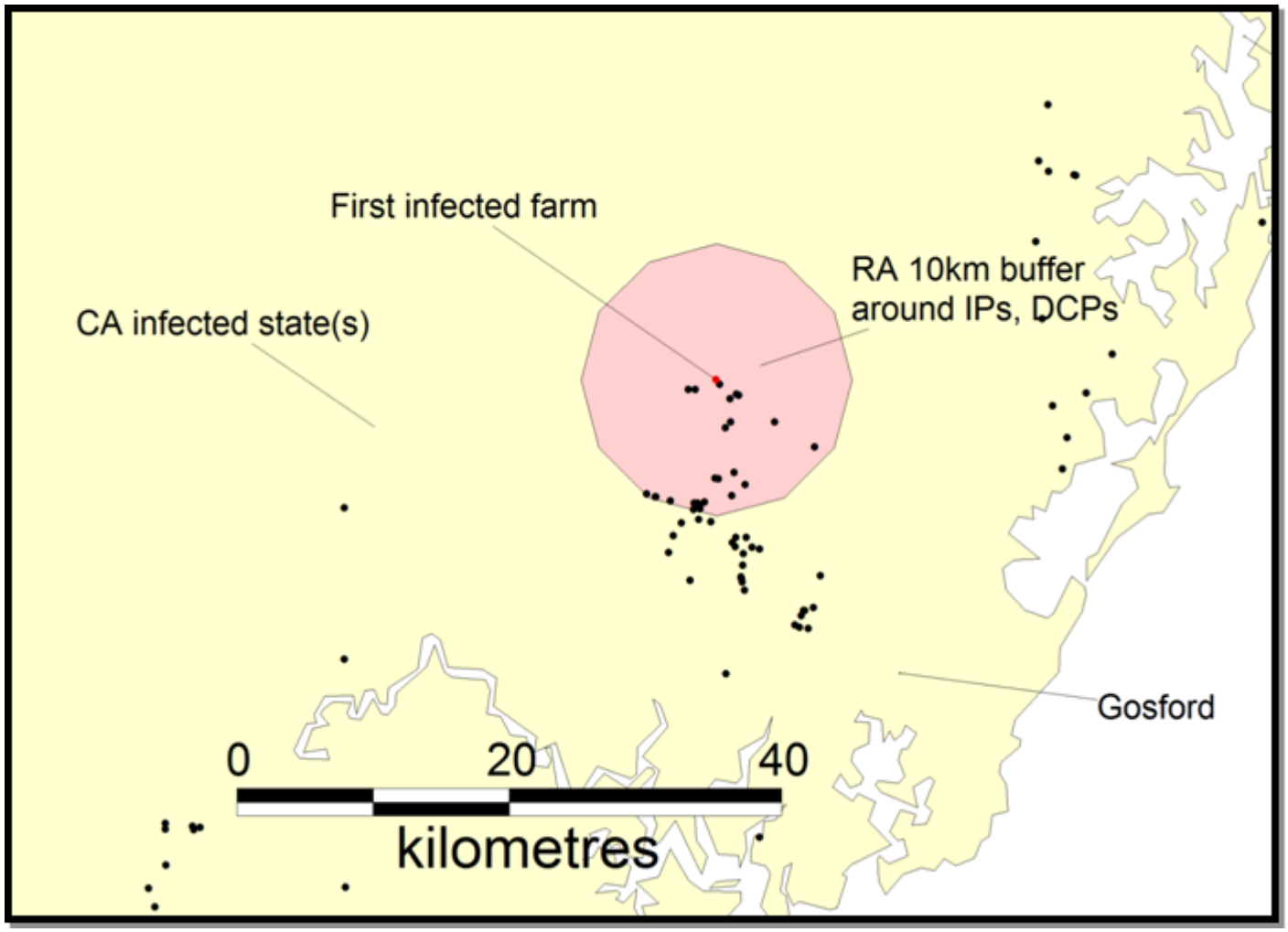
Three control strategies compared

1. Baseline control strategy (BCS)



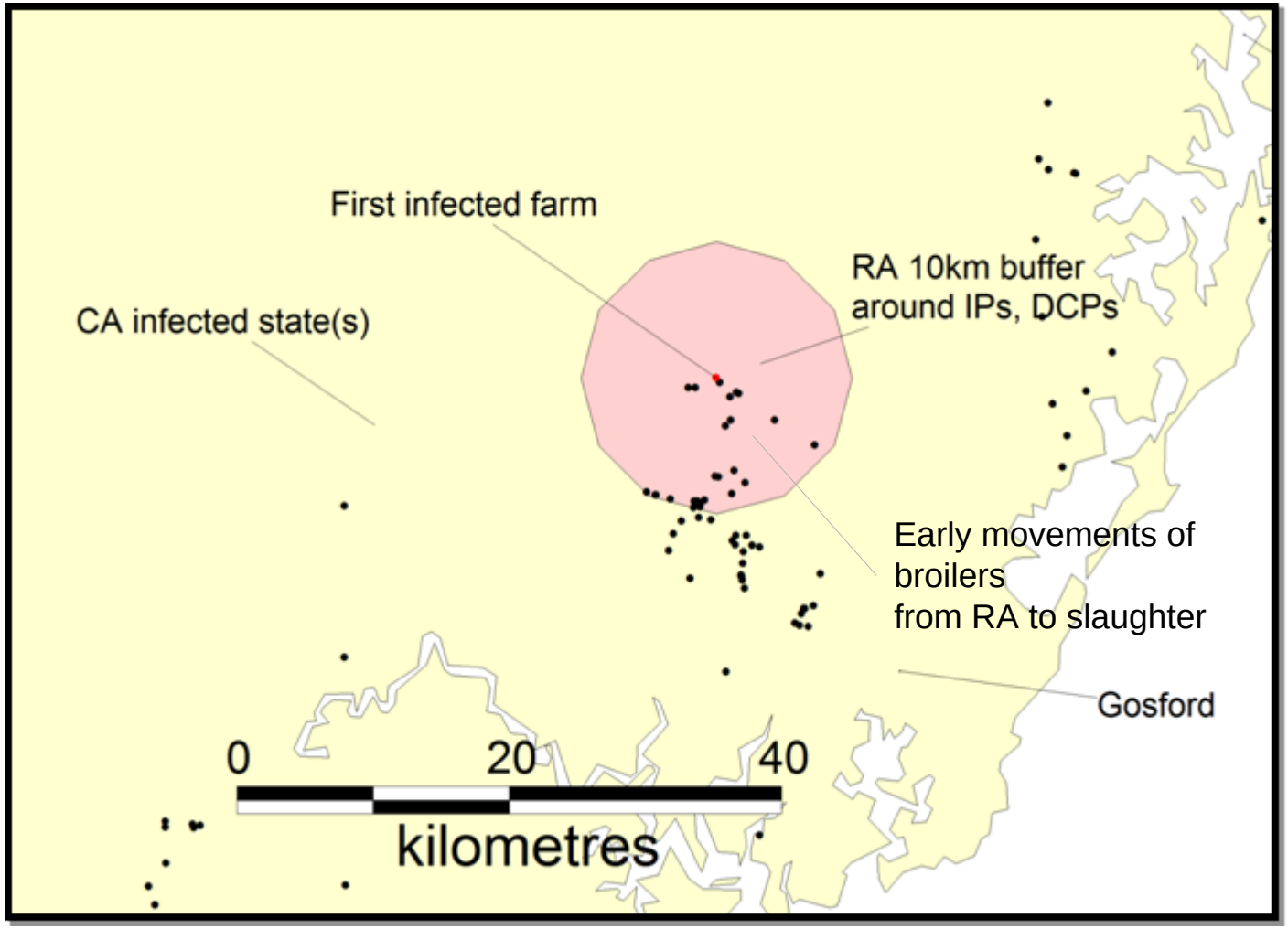
Three control strategies compared

2. Expanded zones



Three control strategies compared

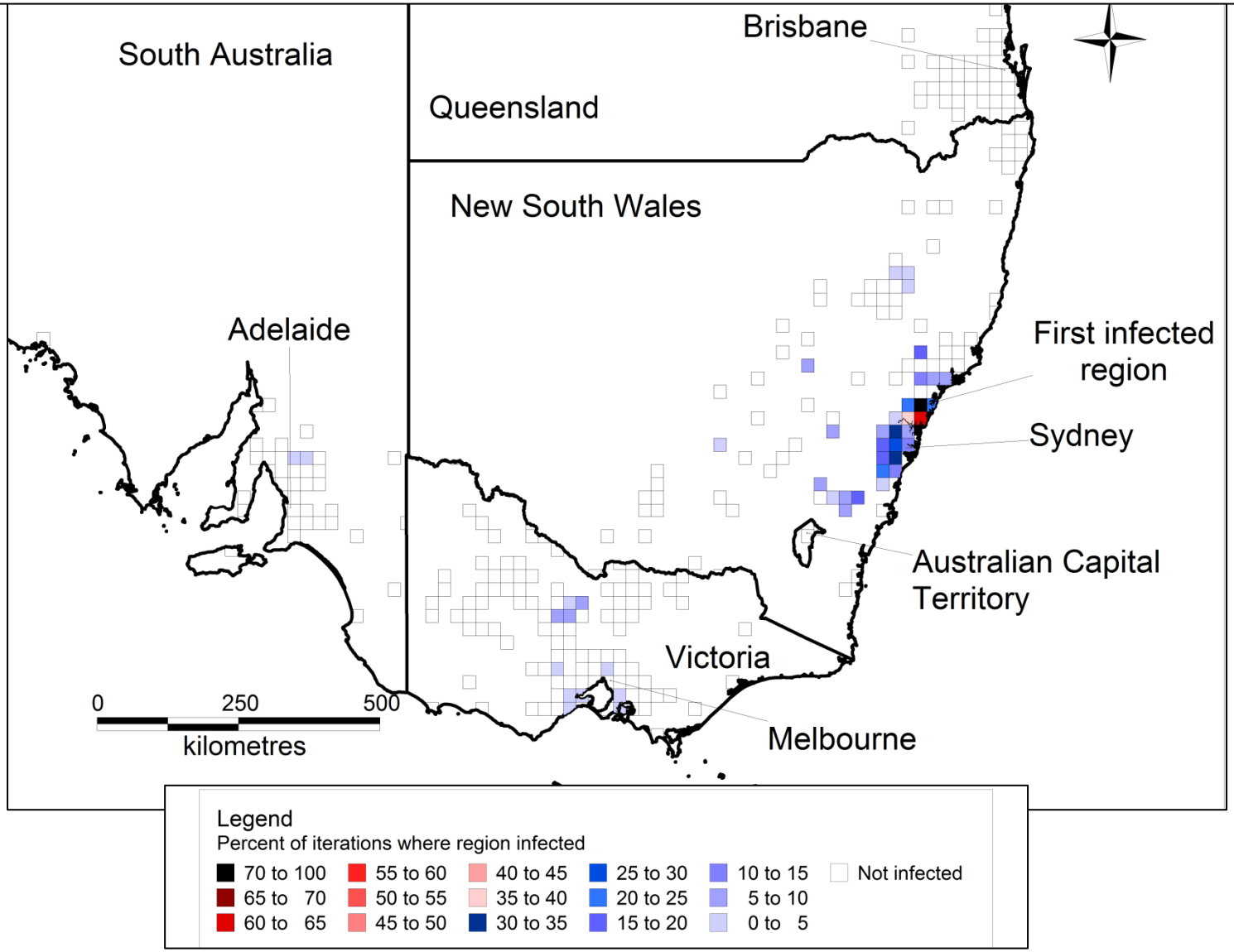
3. Expanded zones and accelerated slaughter of broilers



Methods

- Infection introduced into a broiler farm in the region
- 100 runs per control strategy
- Runs where first infected farm *Empty* discarded
- Medians and 95% probability intervals
- Benefit/cost analysis:
  - Expected values (means)
  - Net benefits vs baseline strategy
  - Benefit cost ratio determined assuming benefits are avoided costs compared with baseline strategy

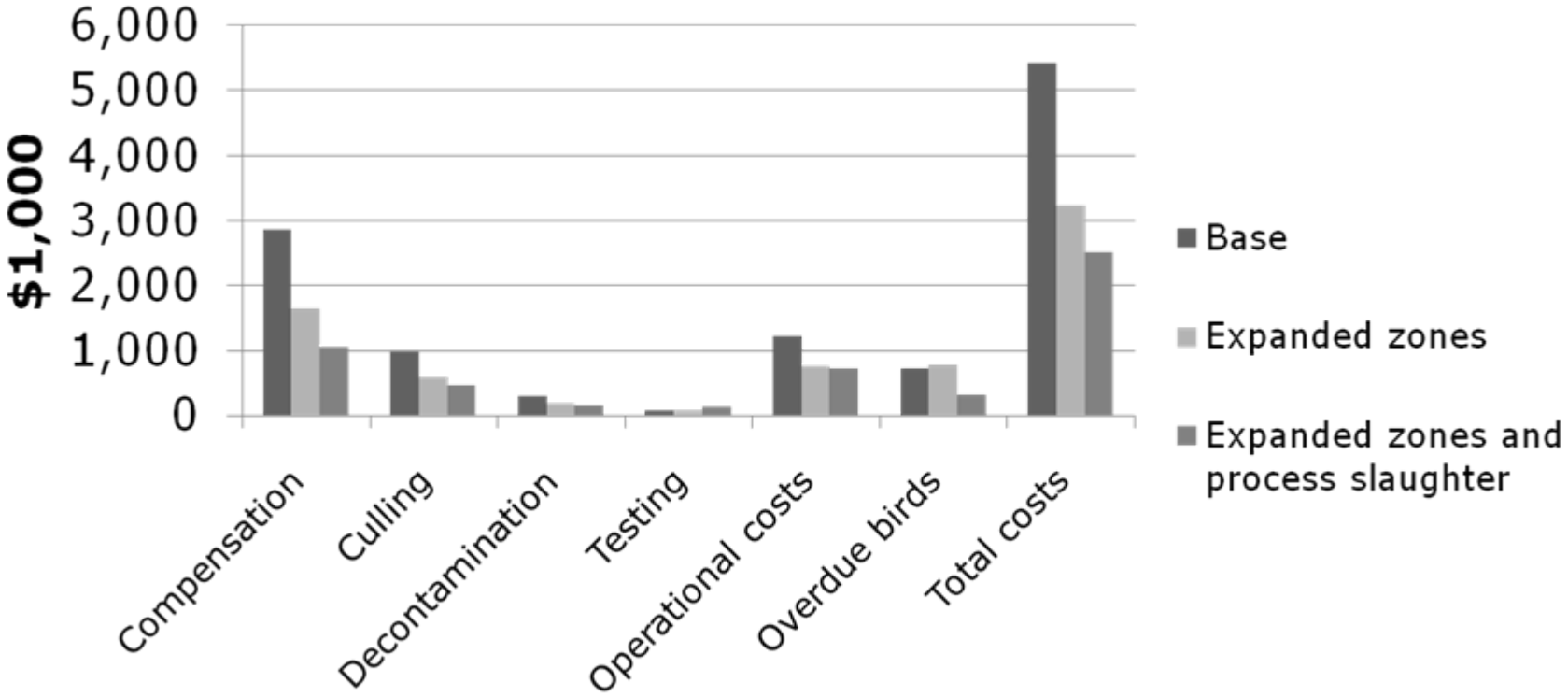
Spatial distribution of infection -- baseline control strategy



Results

			Median (95% PI)			
Strategy	First farm *Empty*	Infection not reported	Epidemic duration (days)	Infected farms	Dead birds (1,000 birds)	Number of farms overdue
Base	24%	6%	23 (14 to 80)	5 (1 to 82)	189 (0 to 4,236)	4 (0 to 81)
Expanded zones	26%	6%	20 (14 to 74)	3 (1 to 45)	121 (0 to 3,662)	12 (0 to 137)
Expanded zone and process slaughter	18%	8%	18 (12 to 68)	3 (1 to 46)	105 (0 to 2,730)	0 (0 to 26)

Results (expected costs)



	Net Benefits ($1,000)	Benefit/cost ratio
Expanded zones	2,195	48.8
Expanded zones and process slaughter	2,909	55.5

Discussion

- Movement restrictions may cause welfare problems on broiler farms as overcrowding occurs

- Impact of movement restrictions worse as control zones enlarged

- Expanding disease control zones whilst processing out farms leads to a minor increase in costs of diagnostic testing, but reduction in spread reduces other costs

- Other results show more costly than baseline strategy in regions with low poultry densities

- Will processing plants stay open???

Conclusions

- HPAI may have significant animal health and economic impacts in high density poultry producing regions
- Preventing broilers moving to slaughter may lead to welfare issues
- Slaughtering out broilers in the RA may be a cost-effective solution, in areas with high broiler farm densities

Thank you

Australian Biosecurity CRC
The “experts”
Office of the Chief Veterinary Officer:
- Graeme Garner
- Sharon Turner
- Iain East
- Peter Black
- Brendan Cowled
- Jonathan Happold
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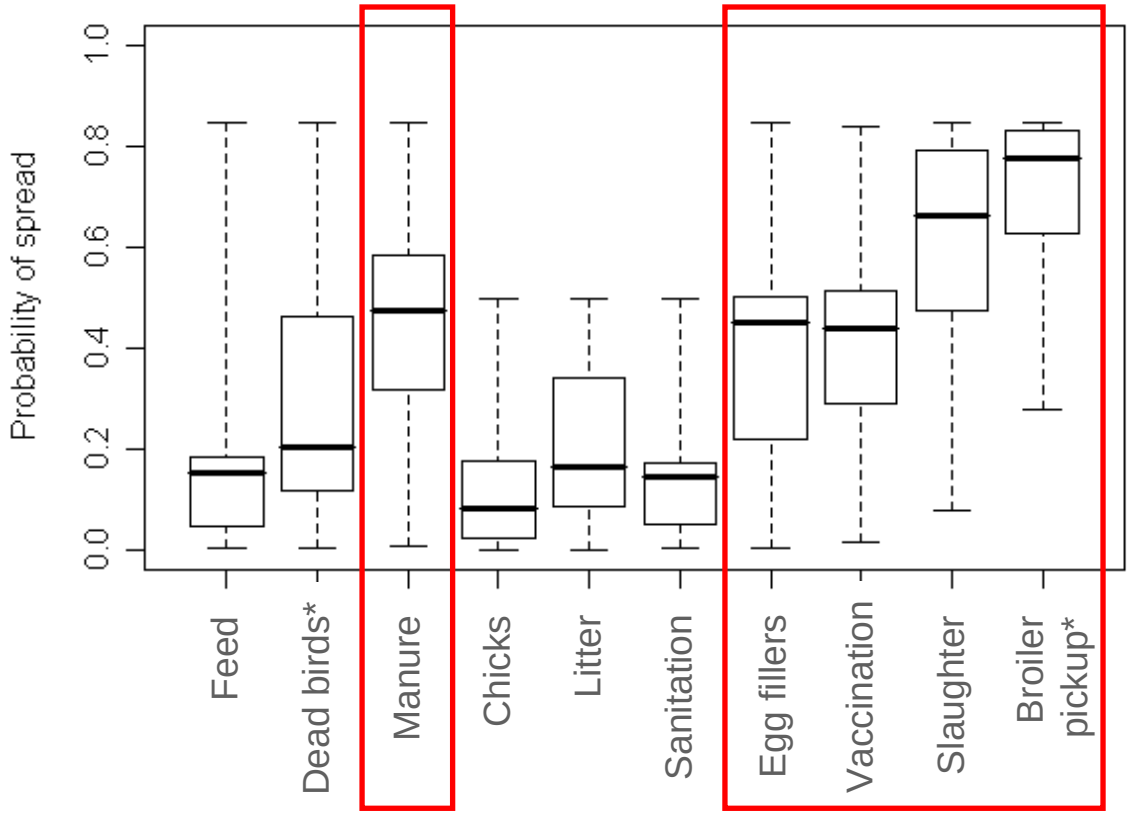
- Jenny-Ann Toribio

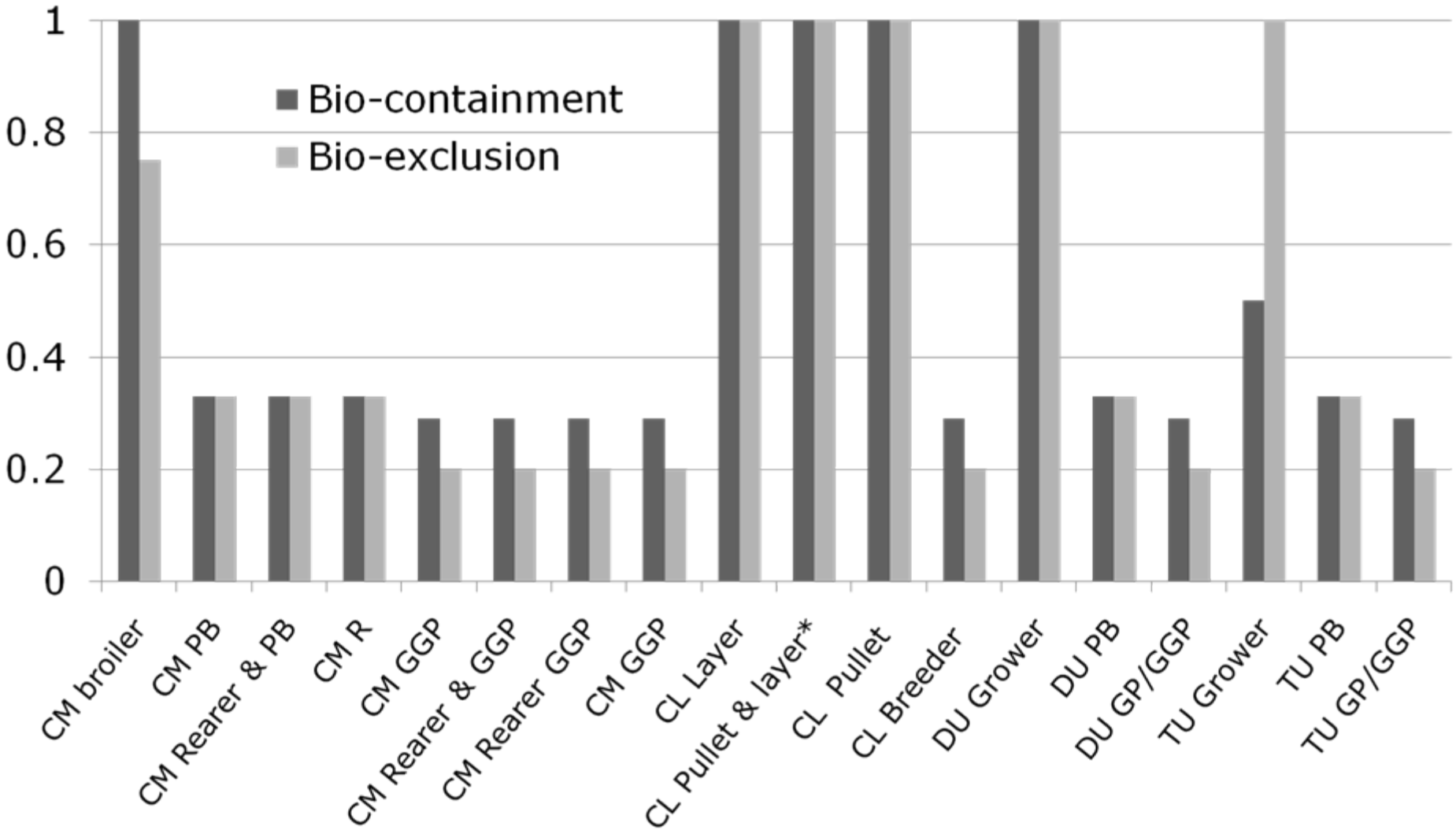
Probability of spread by indirect contacts

Combined distributions



* Scenarios for broiler farms

Biosecurity factors



* Reference farm type