The role of "super-shedders" in the transmission of *E.coli* O157

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Massey / AgResearch

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Ongoing studies

- *E. coli* O157
  - Epidemiology in cattle (Bobby calves)
  - Modelling / control (IMPACT)
  - Genotyping
- Campylobacter
  - Epidemiology in humans and animals
  - Source attribution and control
  - Genomics
- Cryptosporidium
  - Surface and groundwater studies
  - Molecular epidemiology
  - Evaluation of control strategies
- Salmonella
- Leptospira
- Antimicrobial resistance

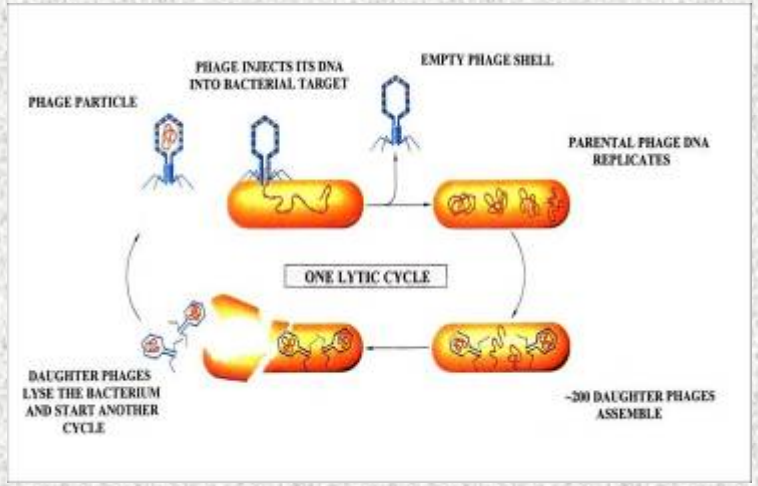
Controlling pathogens in food production chain

Funded by NZFSA, industry, MoH, HRC, FRST, Royal Society

Multidisciplinary, collaborative research

IMPACT (ESR/AgResearch)

- Modelling transmission and phage-bacteria interactions….
- …..to devise and test phage biocontrol strategies
- effects of dose, timing, components…..



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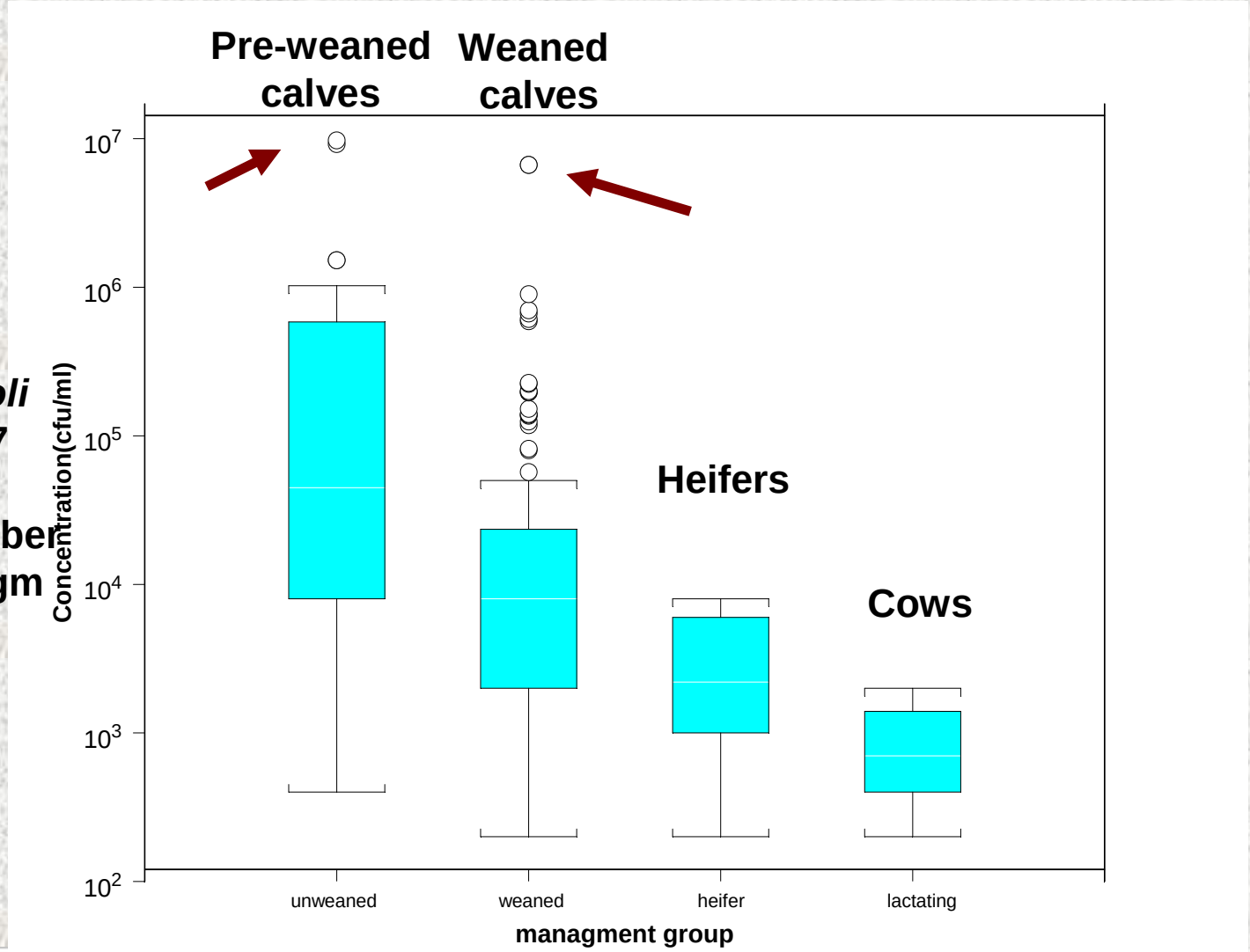
Models will be used to examine effects of:

- Live phage and phage components on bacterial dynamics within animal hosts.
- Live phage on rapidly growing (e.g. super-shedding?) and static bacterial populations.
- Phage (components and live) on STEC populations in animals, farm environment, and food.
- Quorum sensing.

Super-shedders



***E. coli* O157**

Number per gm

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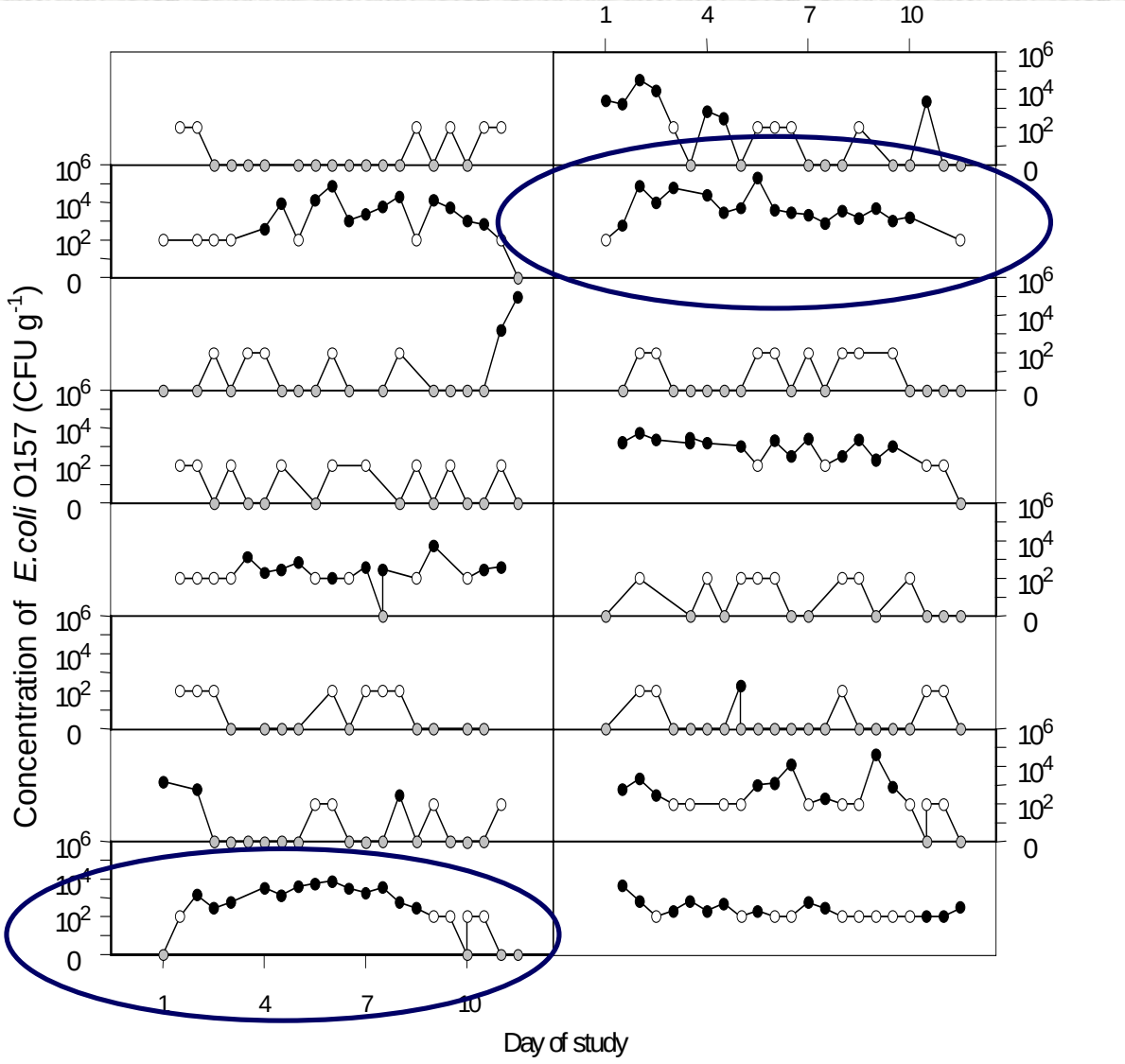
"Persistent" super-shedding



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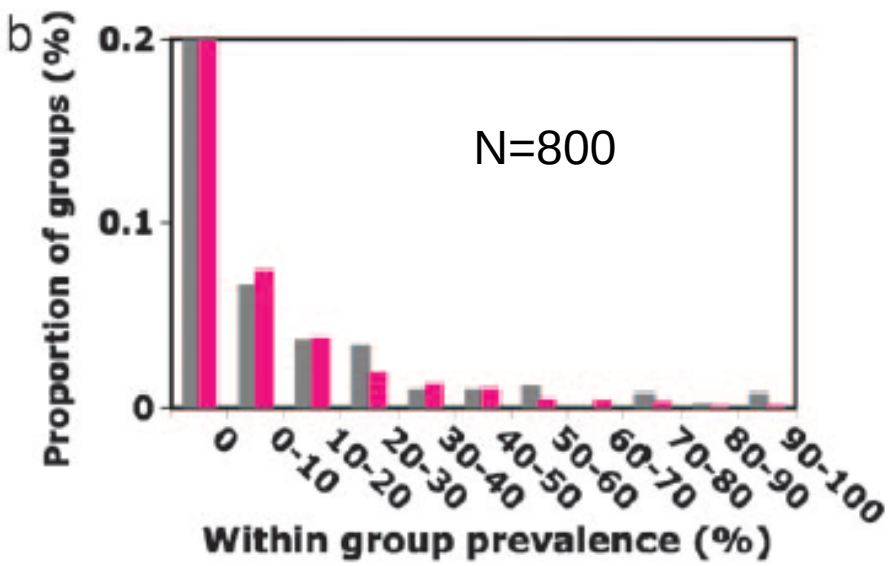
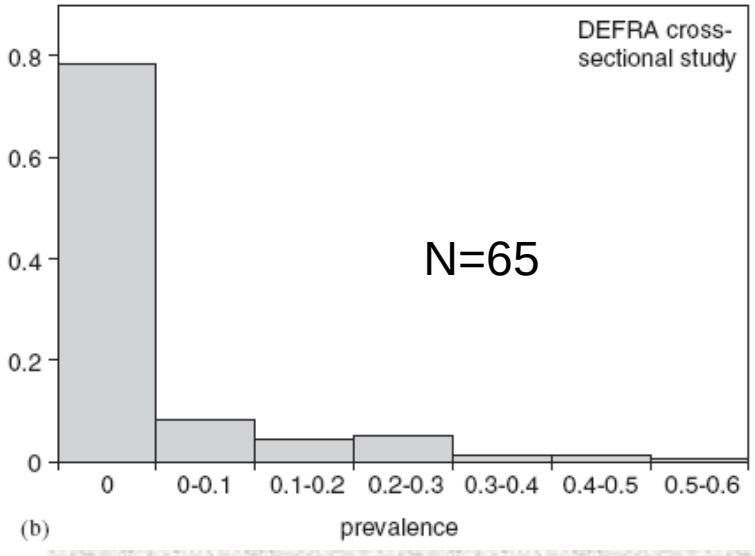
Super-shedders explain skewed distribution of prevalences





Scottish beef farms

Cheshire dairy farms

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The role of super-shedders and super-spreaders

- Farms (between farm spread)
- Animals (within group / farm spread)
- 80:20 rule
  - 80% of new infections result from 20% of high shedding individuals
- Shedding related to age, management group, management system and stage of infection
  - Effect of changes in husbandry?
- RAJ

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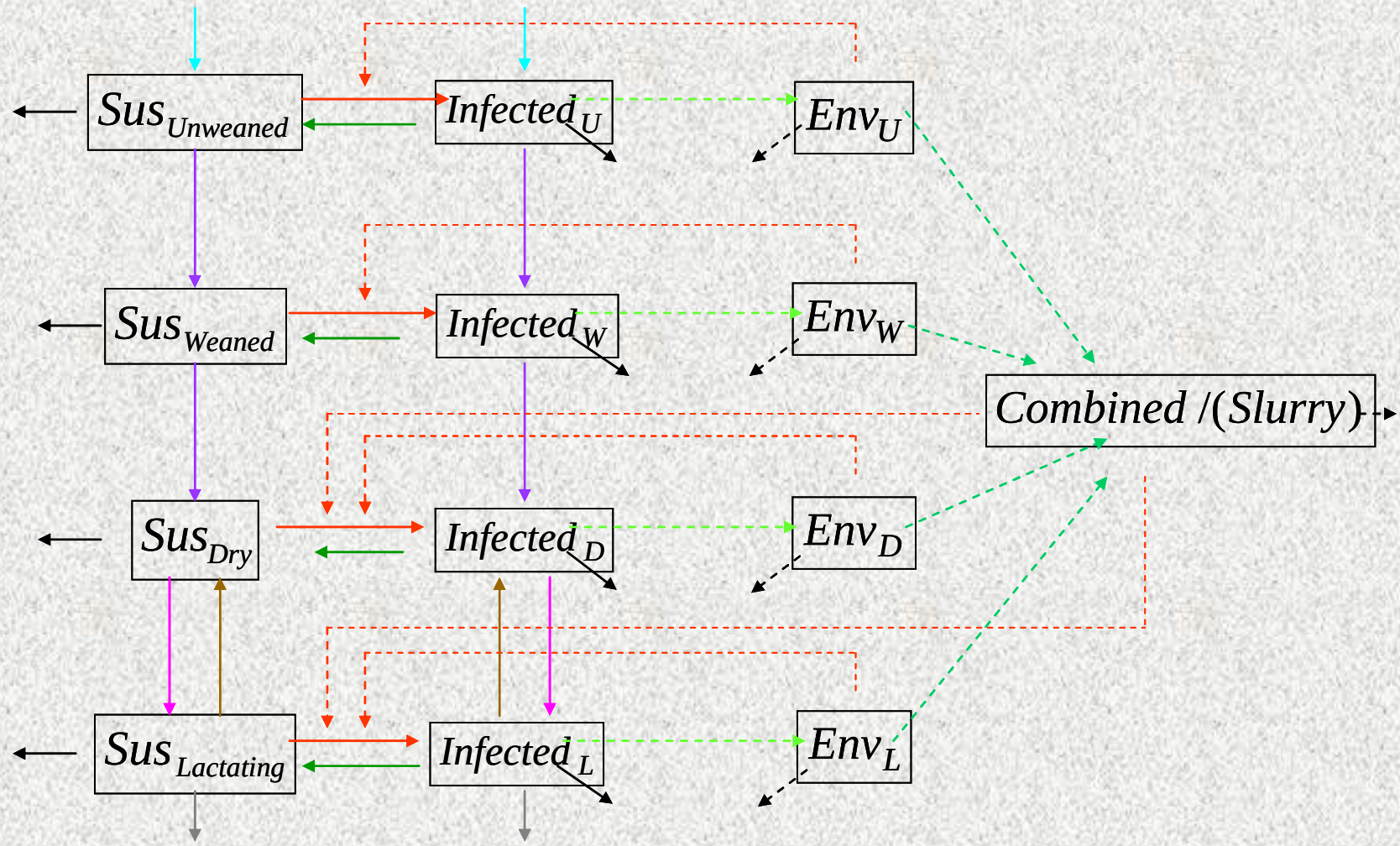
Modelling a dairy herd



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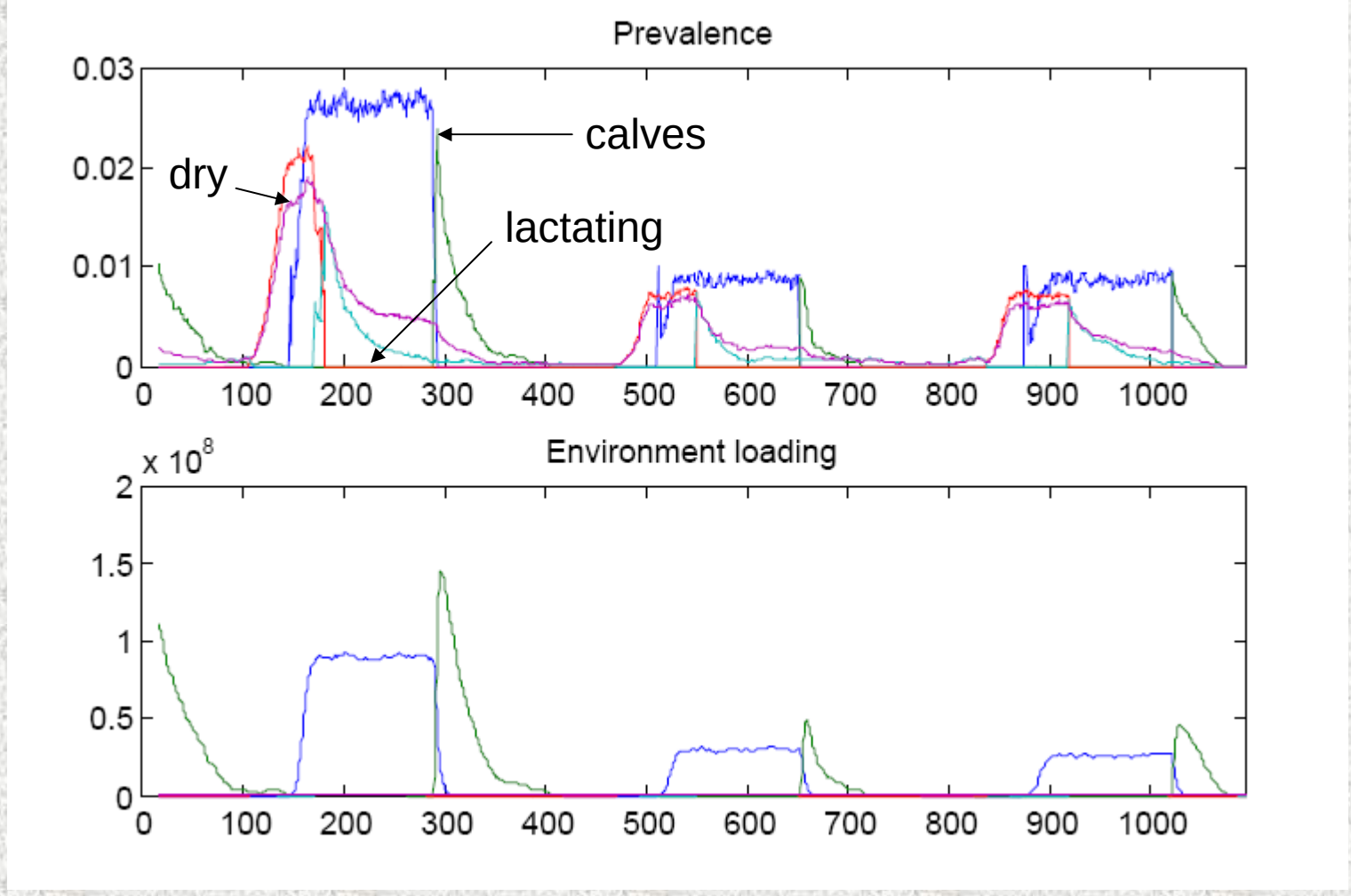
Super shedding: Modelling

- Allow persistent high shedders (sample at birth)
- Allow transient high shedders (sample at time of infection)
- Allow transient shedding while infected (resample periodically during infection)

New Zealand STEC model (J. Marshall)



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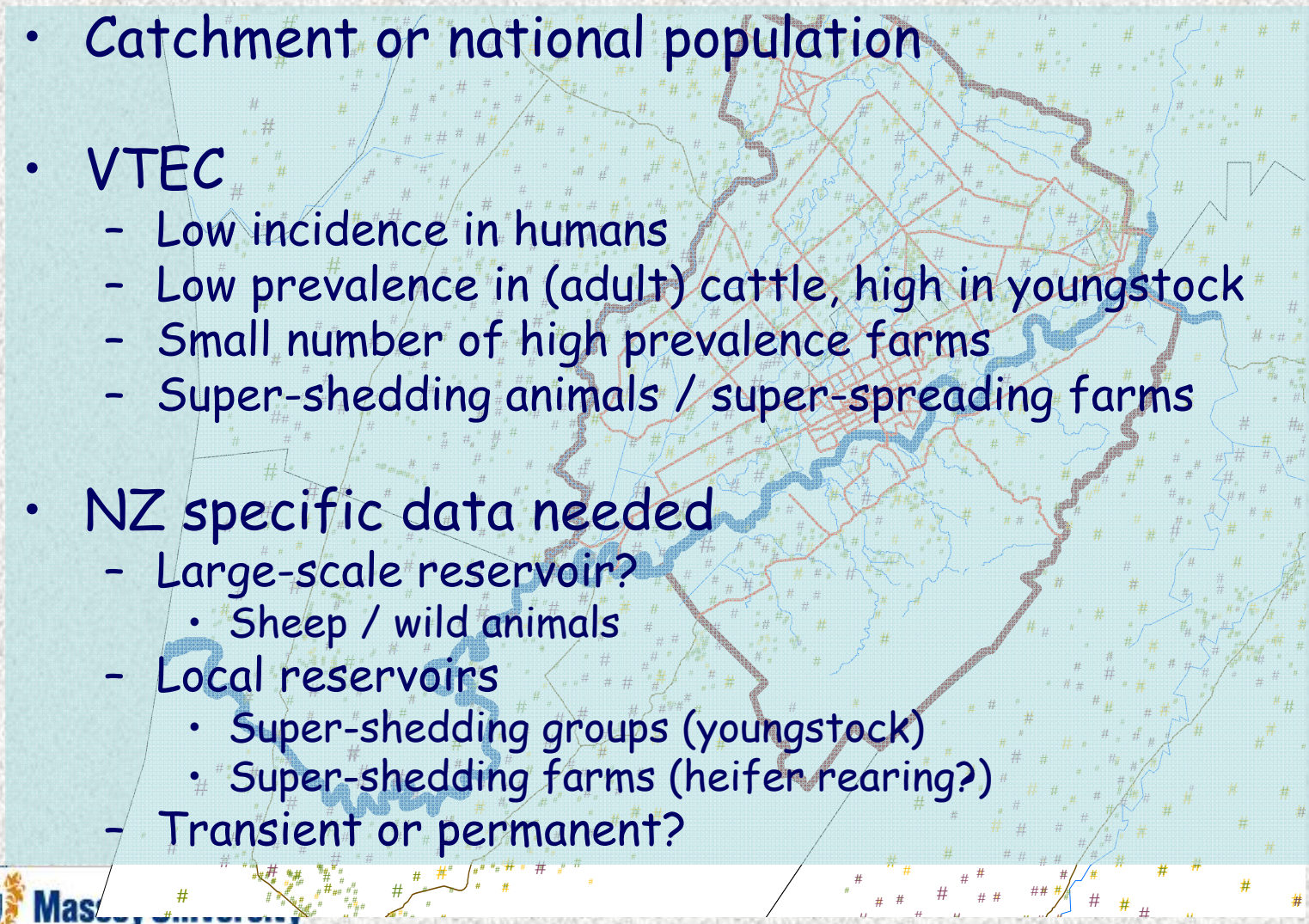
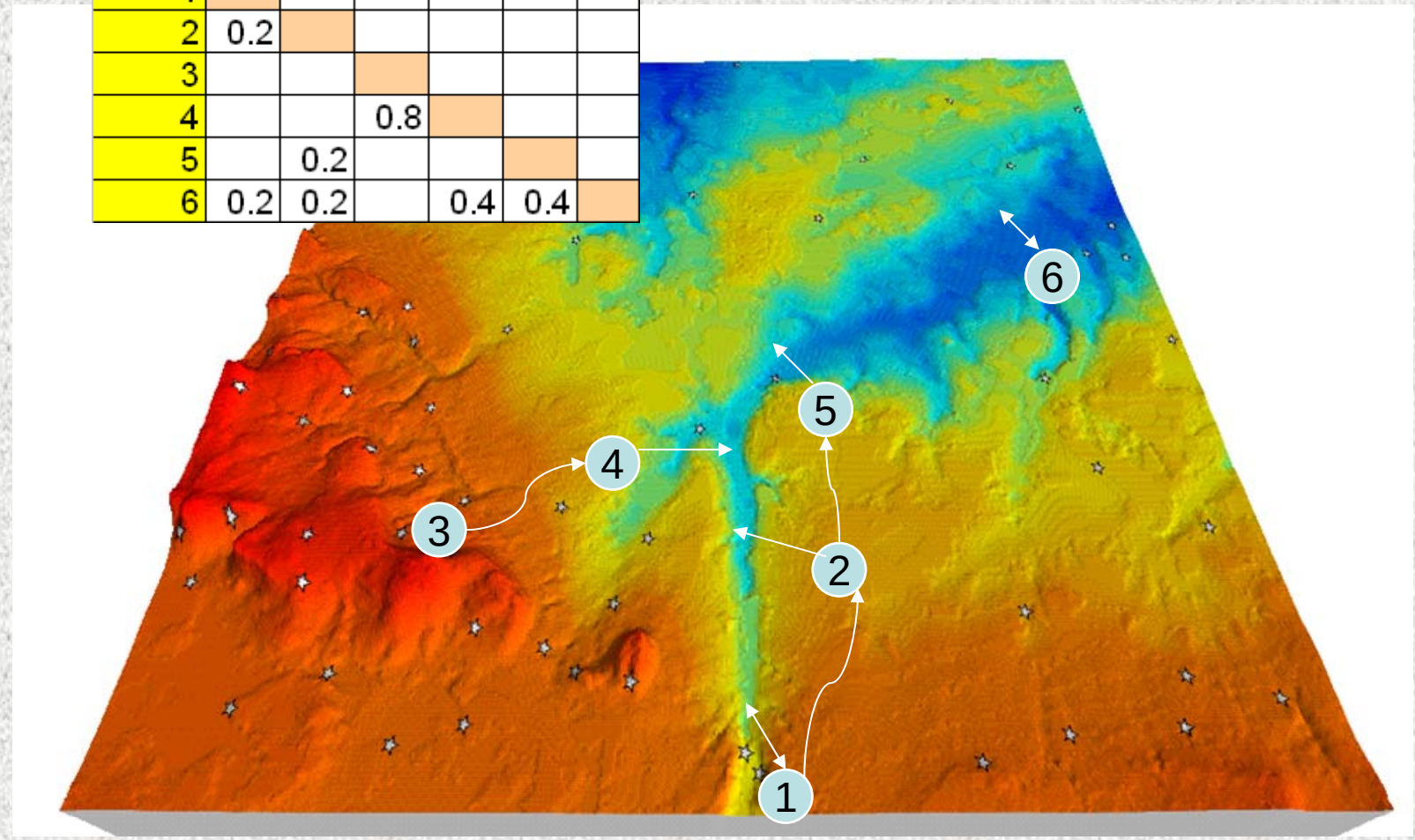
Persistence in a farm "metapopulation"

- Catchment or national population
- VTEC
  - Low incidence in humans
  - Low prevalence in (adult) cattle, high in youngstock
  - Small number of high prevalence farms
  - Super-shedding animals / super-spreading farms
- NZ specific data needed
  - Large-scale reservoir?
    - Sheep / wild animals
  - Local reservoirs
    - Super-shedding groups (youngstock)
    - Super-shedding farms (heifer rearing?)
  - Transient or permanent?



Dairy catchment

	1	2	3	4	5	6
1						
2	0.2					
3						
4			0.8			
5		0.2				
6	0.2	0.2		0.4	0.4	



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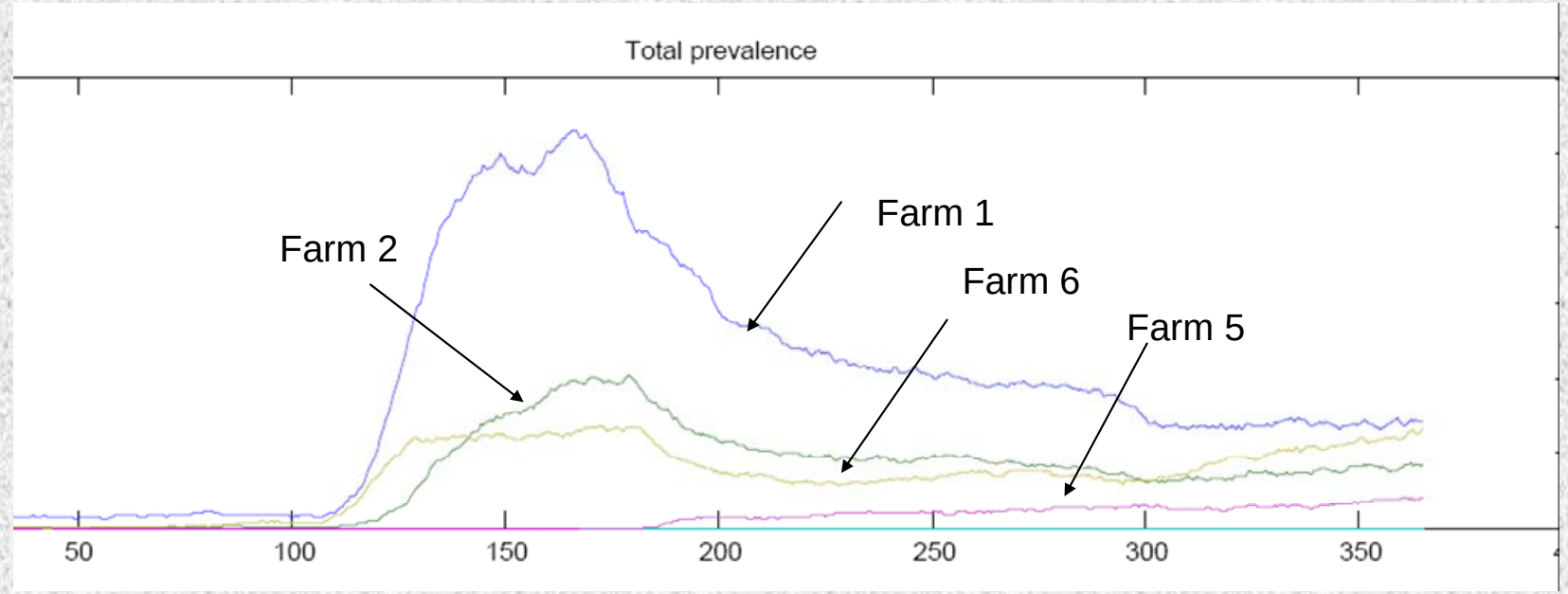

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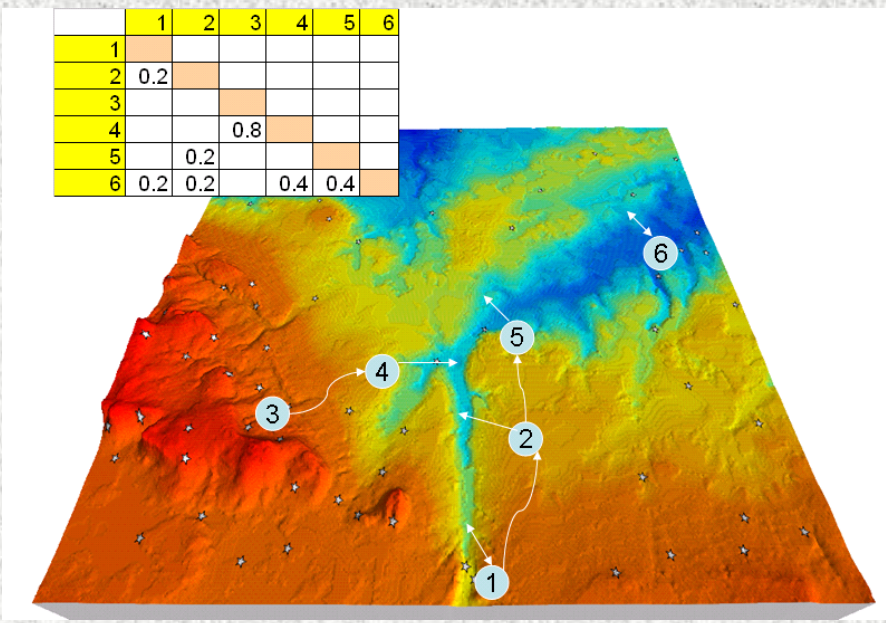

Single animal farm 1

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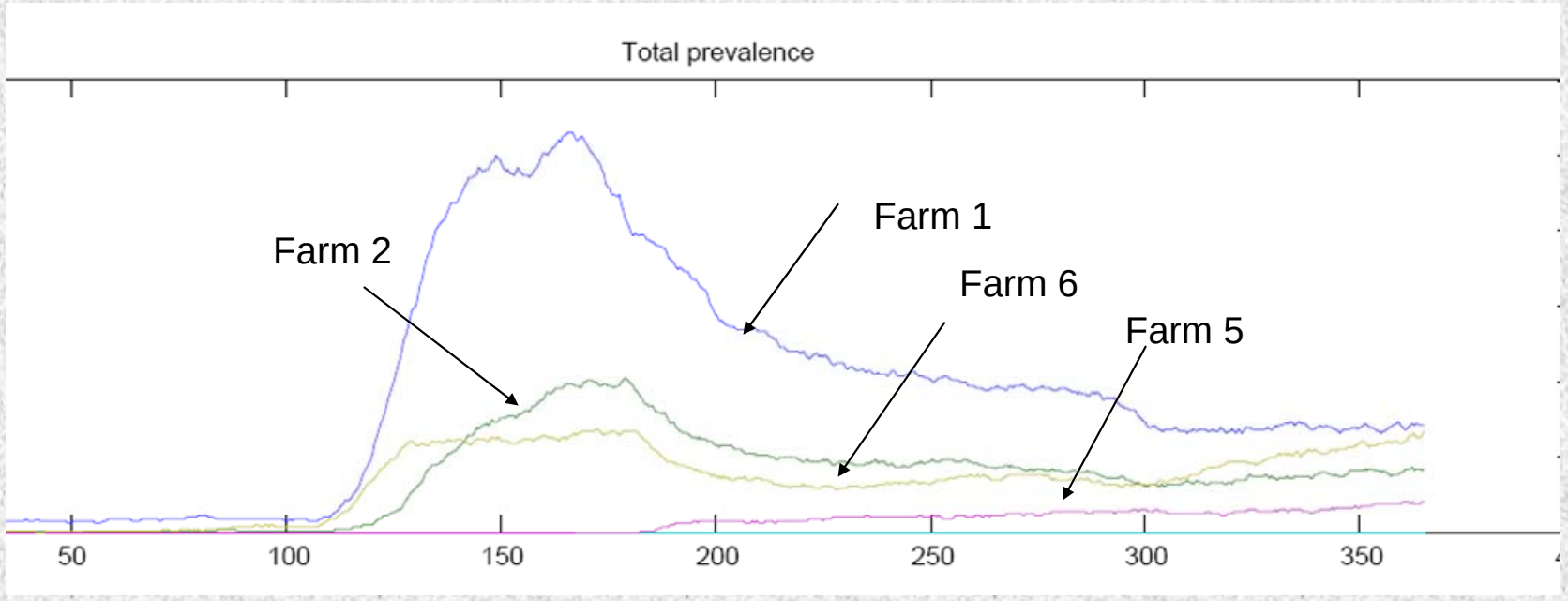
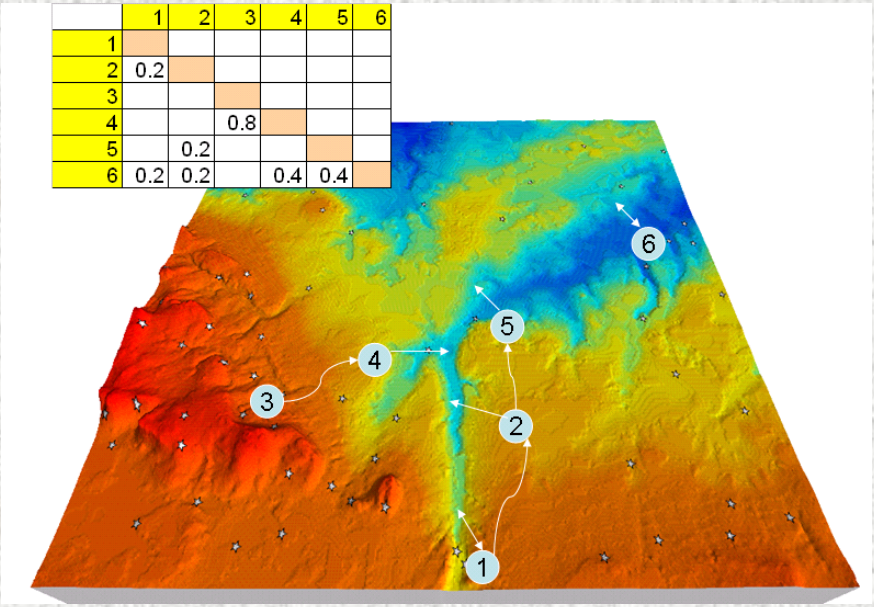


Single animal farm 3

	1	2	3	4	5	6
1						
2	0.2					
3						
4			0.8			
5		0.2				
6	0.2	0.2		0.4	0.4	



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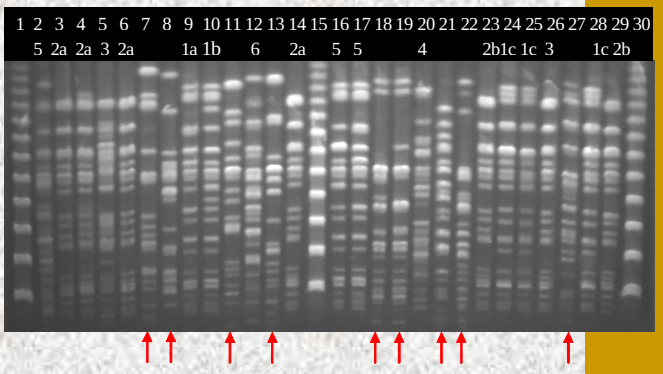
Data needs

- **We have limited information on the basic epidemiology of VTEC O157, and other non-O157 STECs in New Zealand**
  - How prevalent?
  - Which livestock units?
    - Herd homes, feed pads
  - Which strains?
  - Transient and permanent reservoirs?
  - Farm metapopulation / catchment dynamics?
  - Super-spreaders / super-shedders?
  - Risk factors for carriage?

We need….

- Prevalence data
  - Cattle and sheep
  - Within farm, random selection
  - Genotyping of isolates
  - Role of super-spreaders (heifer rearing units?)
  - Identify transient and permanent reservoirs
- Longitudinal shedding data
  - Seasonality
  - Role of super-shedders
  - Targeting of interventions
    - Effects of control on high shedders



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EpiCentre Hopkirk Team

- **Staff - lecturers**
  - Dr Eve Pleydell, Dr Deb Prattley
- **Postdocs**
  - Dr Simon Spencer, Dr Jonathan Marshall, Dr Anne Midwinter, Dr Julie Collins-Emerson
- **Lab team:**
  - Rebecca Pattison, Rukhshana Akhter, Errol Kwan, Lynn Rogers, Isabel Li, Jim Learmonth, Anthony Pita, Sarah Vaughan,
- **PhD students**
  - Hamid Irshad, Petra Mullner, Vathsala Mohan,
- **Masters students**
  - Tui Shadbolt +

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