

Johne's Disease and its Impact on Red Meat Production

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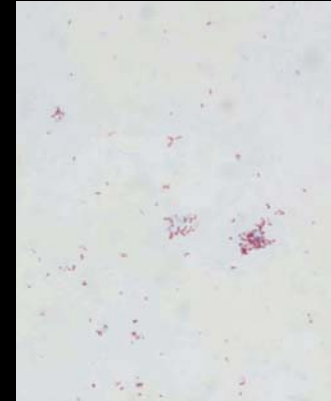


<http://www.otago.ac.nz>

Mycobacterium avium spp *paratuberculosis* (*Map*)
causes Johne's disease



Map looks harmless

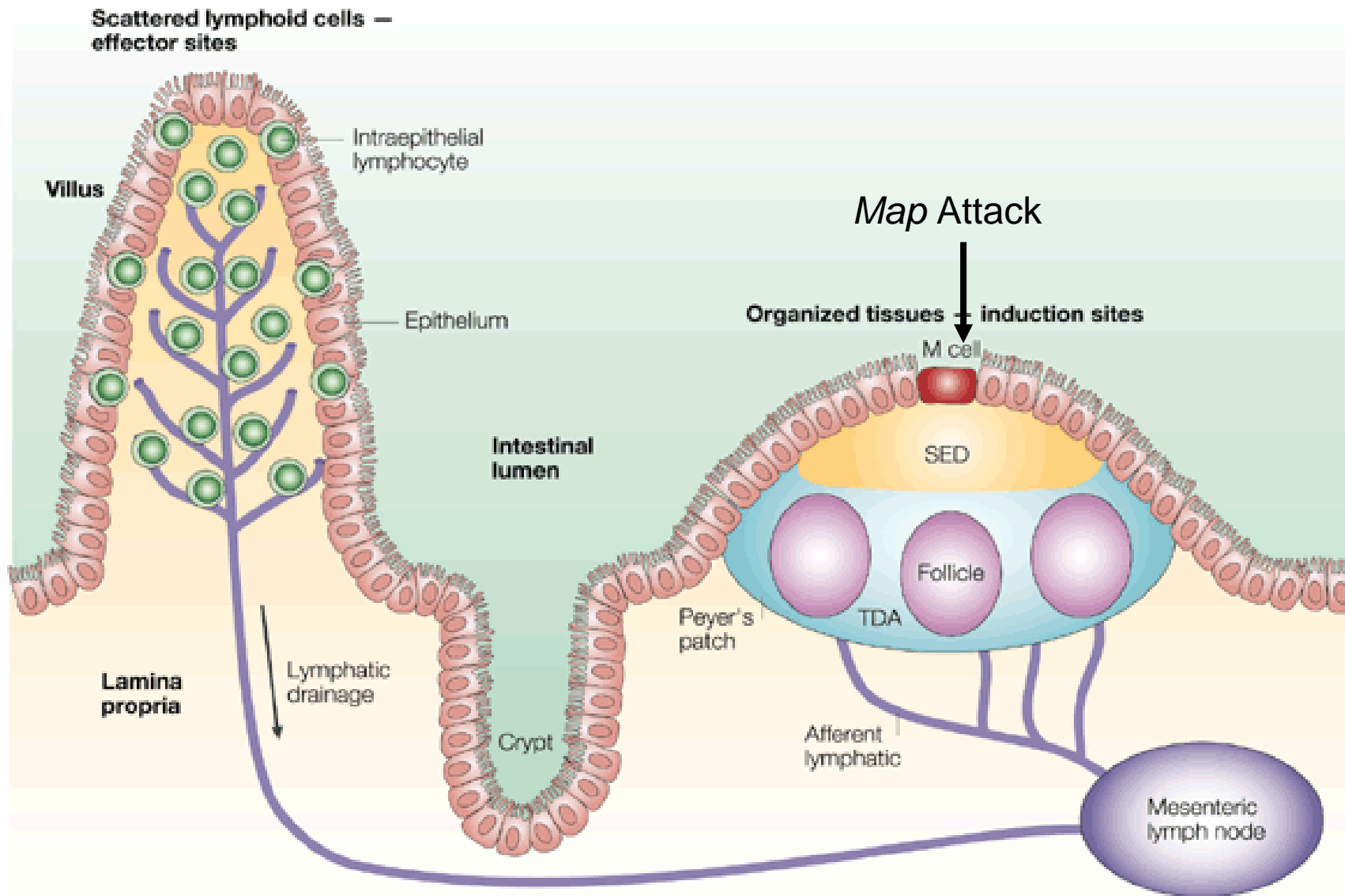


Map has waxy cell wall



Map grows very slowly

A *Map* Attack in the gut tissues of animals



**Severe Haemorrhage/Thickening
Map attack (deer)**



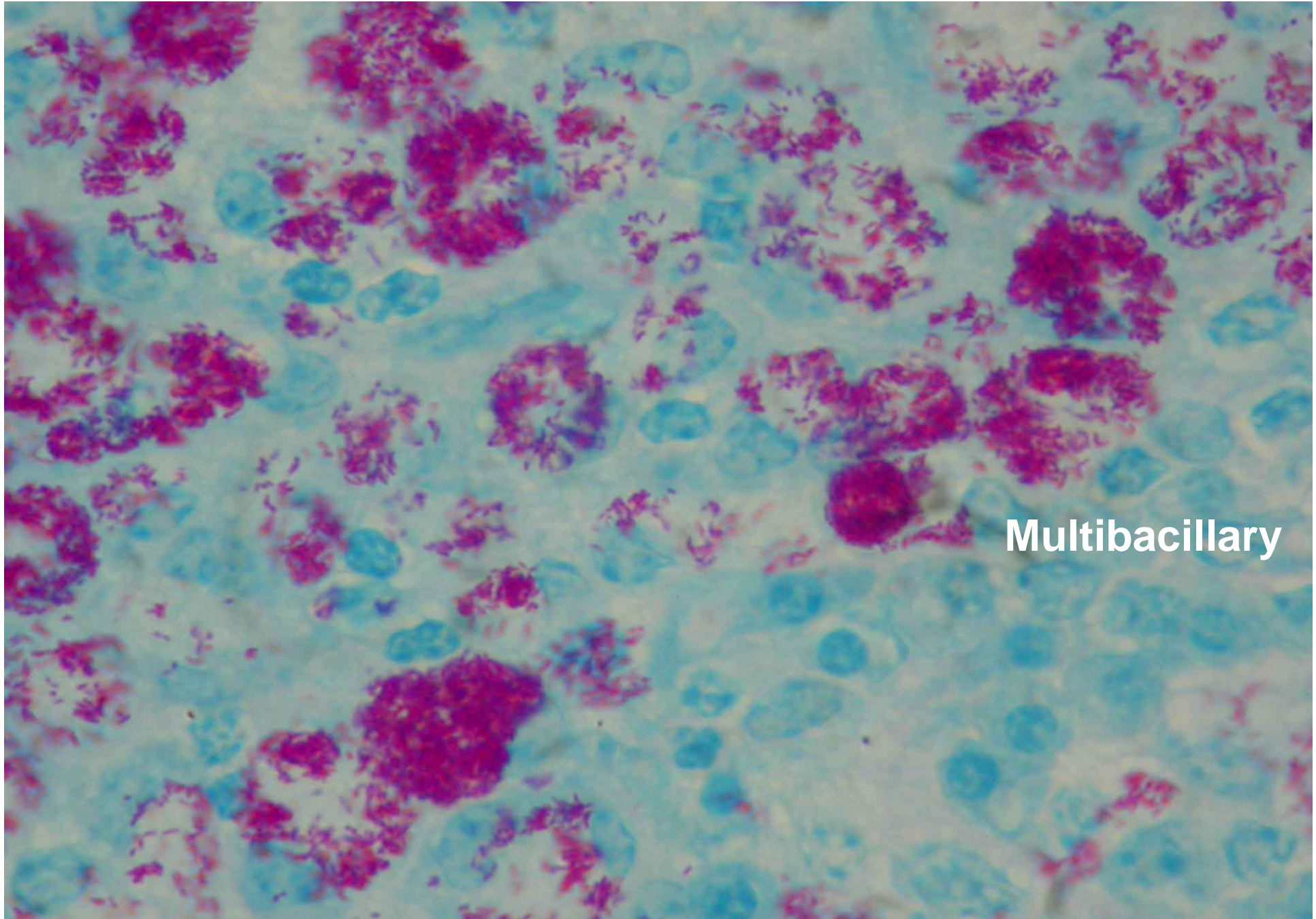
Gut thickening after *Map* attack (cattle)



(c) IvoPavlik

*****This looks remarkably similar to
Crohn's Disease in Humans**

Extreme form of *Map* attack in deer gut tissues



Multibacillary

Extreme *Map* attack in deer mimics Tb



Causative agent: *Mycobacterium avium* spp *paratuberculosis*
(Map)

Transmission of Map

- Faecal - Oral
 - Highest risk to young fawns.
 - May be controlled by improved farm hygiene
- Mother - Fetus
 - May occur commonly with seriously diseased hinds (Colostrum after birth)
- Relative risk
 - Deer to deer > Cattle to deer > Sheep to deer to deer

Strategies for Map control

- Different for each species (cattle, deer & sheep)
- Epidemiological (define risk and transmission)
- Management Options
 - Diagnostics
 - Microbial (fecal-live or tissue -dead)
 - Immunological (Deer > Cattle > Sheep)
 - Vaccination
 - Cross reactivity in Tb testing (Sheep < Cattle and Deer)
 - Select for Heritable Resistance
 - Generic for all 3 species

Diagnosis of Map in farmed animals

- Microbial culture
 - Slow (6-24 weeks)
 - Most sensitive with Pm tissues (***Gold standard***)
- Histopathology
 - Difficult to distinguish from TB
- Immune diagnosis
 - Cross reactivity with other bacteria

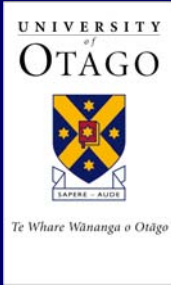
Serology: An IgG1 ELISA for diagnosis of Infection

Sensitivity of Test

- No. Test (+)/Total No. Infected.

Specificity of Test

- No. test (-)/Total No. Not-infected.



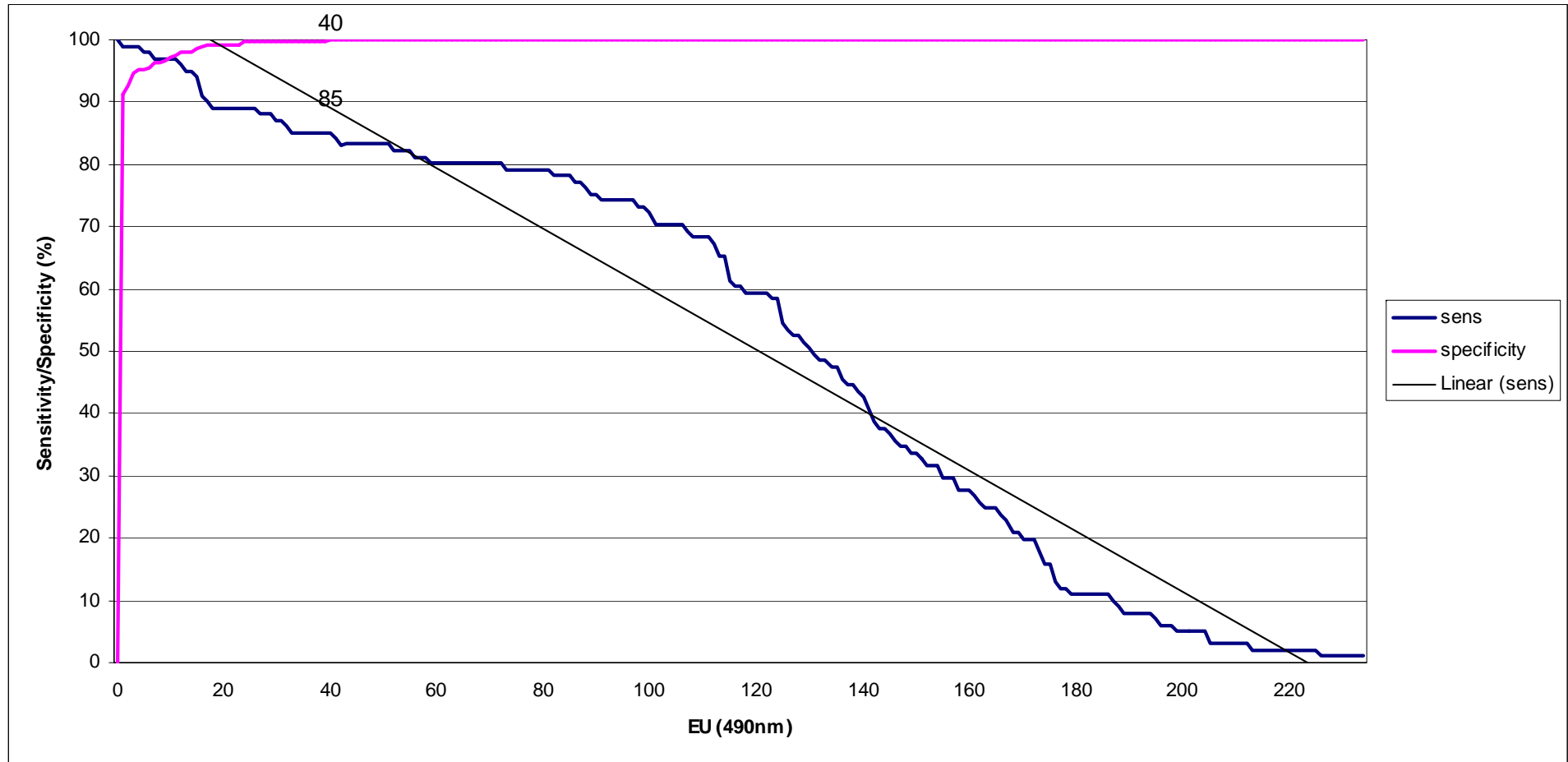
Dataset for establishing Test Parameters

Sensitivity : 300 Johne's disease animals

Specificity : 500 Uninfected animals

Use ROC analysis of data retrospectively
to establish cutpoints for the assay

Specificity and Sensitivity values with PpAg



The Test might be viable !!

Relationship : ELISA(+) and disease severity

		Lesion-positive animals		
		Culture (+)		
		H-1	H-2	H-3
ELISA(+)	77/100	39/43	37/40	66/67
ELISA sensitivity	77%	91%	93%	98.5%

Inverse Relationship: Antibody & Disease Severity

Disease is the exception with Map Infection

Farm	No. Killed	Johne's disease	MAP +ve
A	24	1	21
B	10	3	10
C	17	1	17
D	10	0	10
E	12	0	12
F	13	1	13
G	15	1	15
H	15	1	12
Total	116	8 (6.9%)	110 (94.8%)

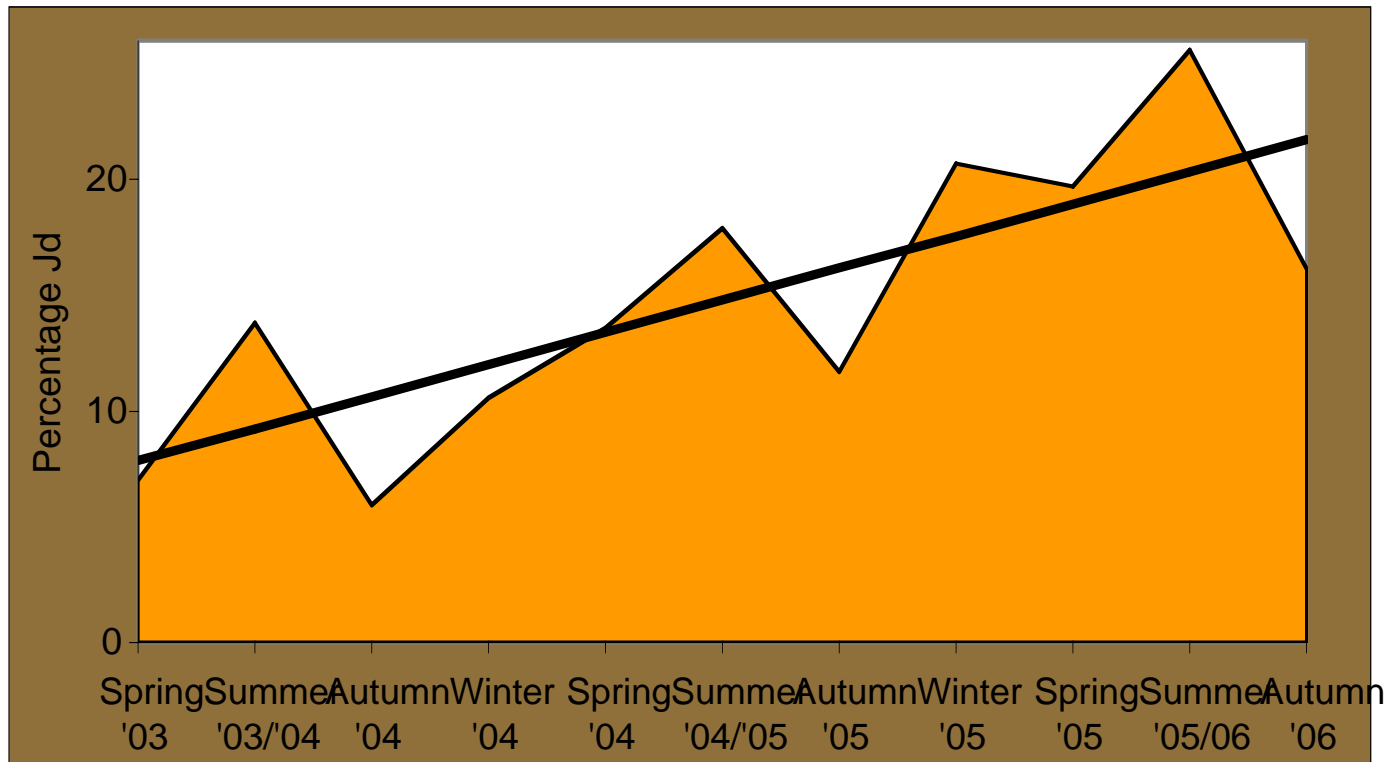
Most JD animals are undetectable at Meat Inspection

Proportion of Herds with Jd Reactors

	Herds Tested	Number <i>MAP</i> (+)	%
NI	122	76	62.3%
SI	525	332	63.2%

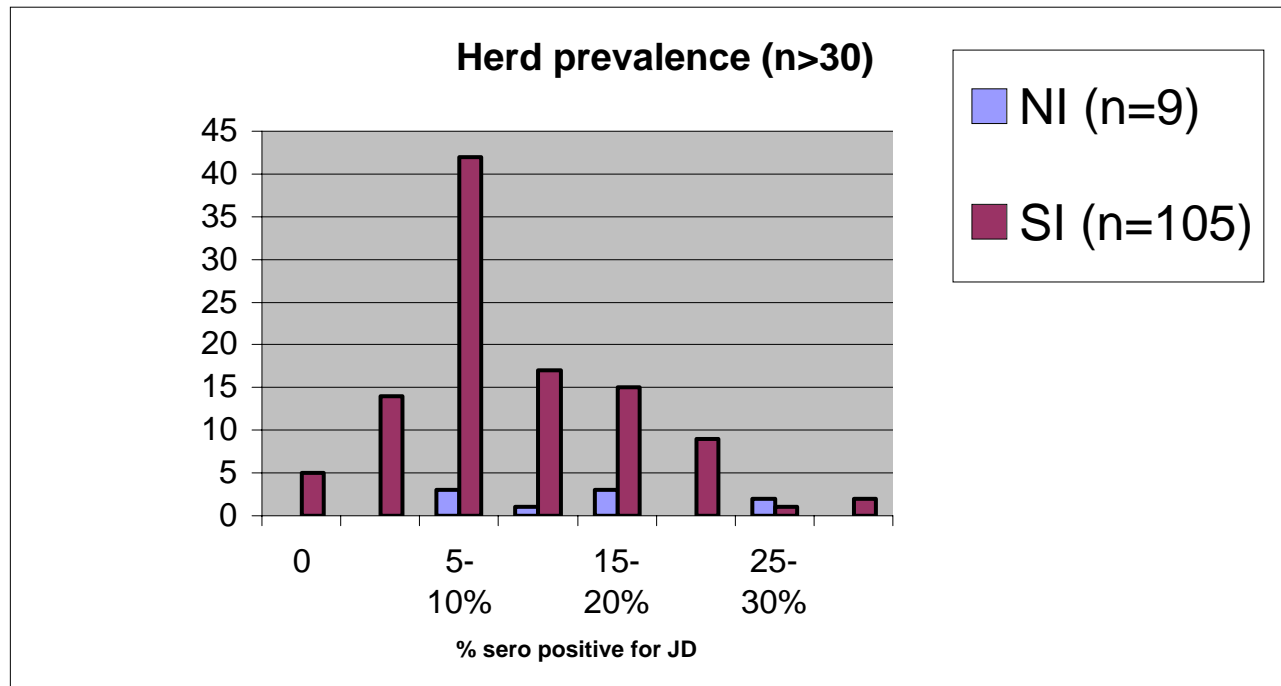
- ❖ ***Map* infection is widespread equally throughout New Zealand**

Trends for Jd Reactivity in Deer



*** *Map* infection is increasing annually throughout NZ**

Reactor rate in infected herds



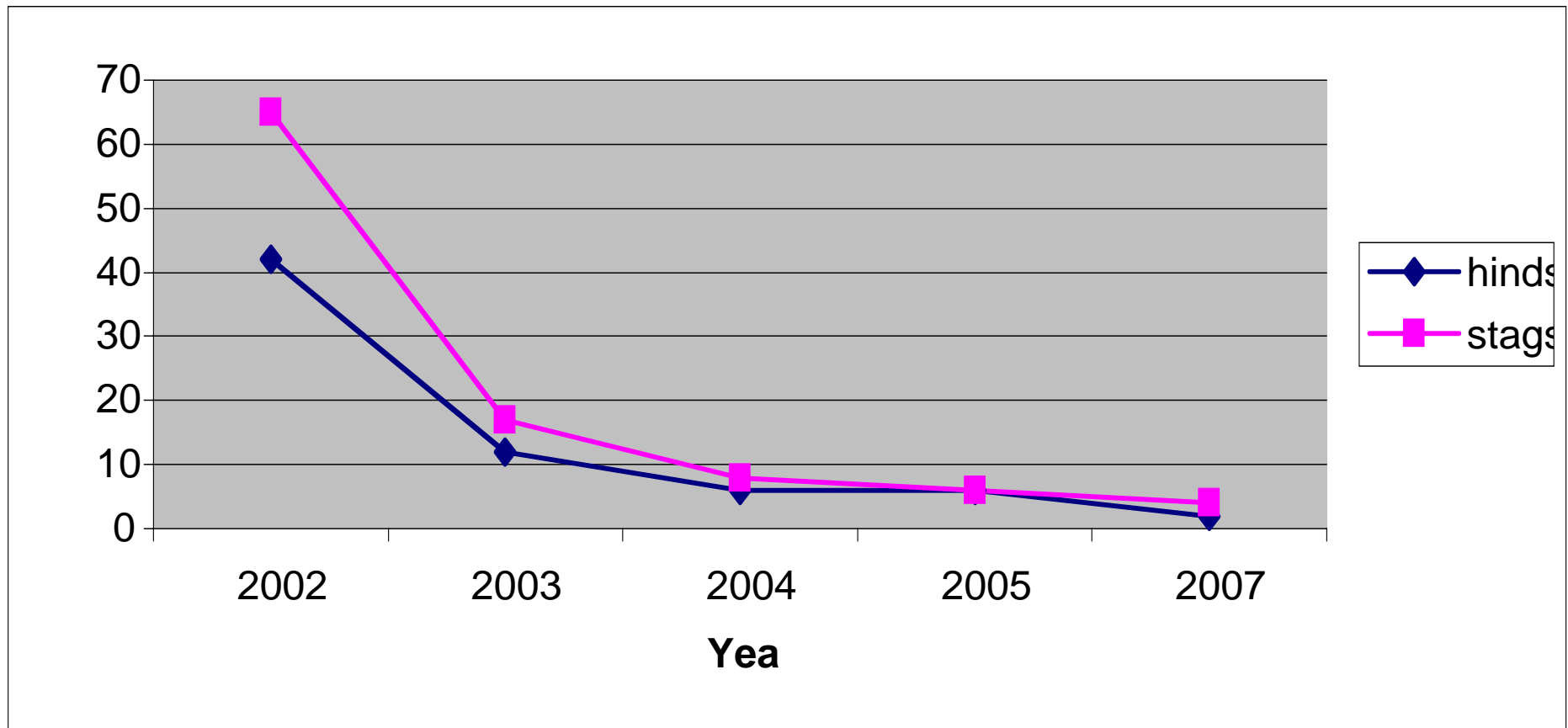
South Island n = 31,508

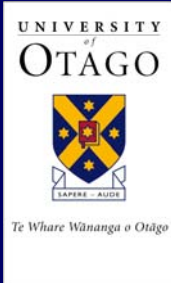
North Island n = 2,249

2006 Data

❖ **2007 data shows increase to higher infection levels**

Serodiagnosis : *Map* Infection in a Herd involved in a Control programme





Production values and death rates in young deer relative to IgG₁ ELISA status

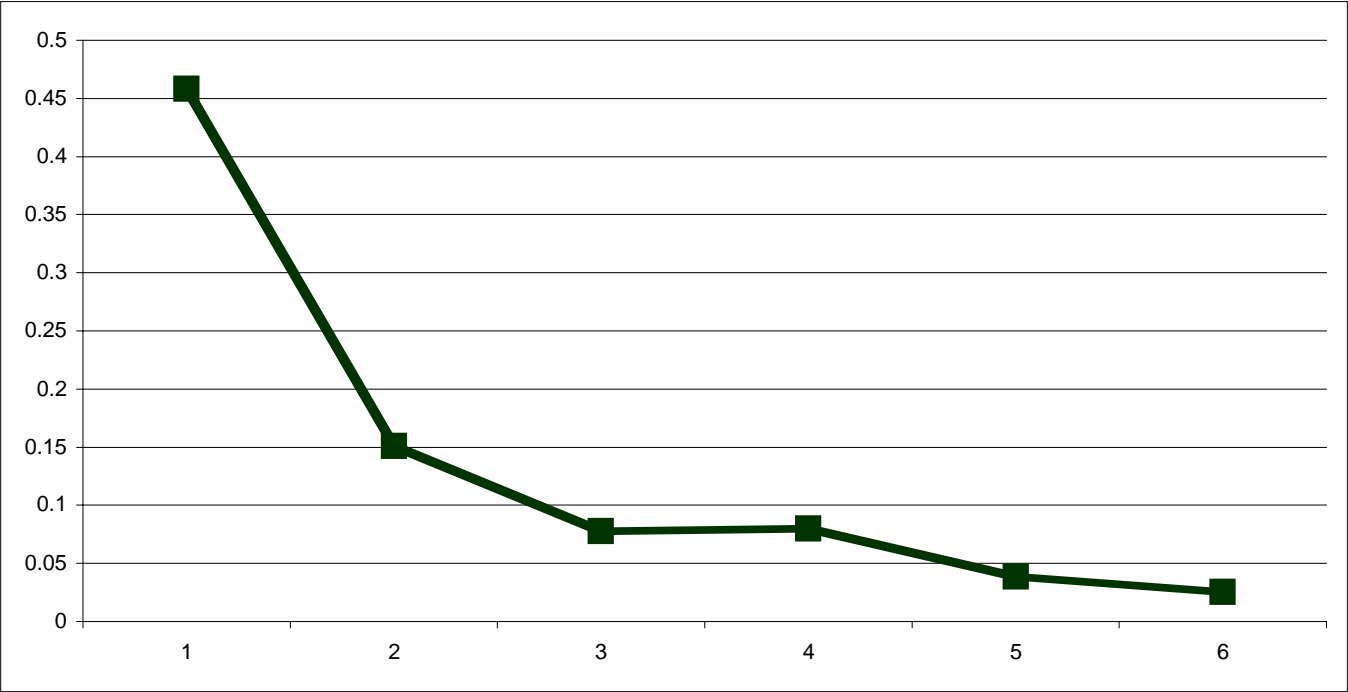
Total	IgG₁ test result	Death Rate	Mean weight (15 mo)	Percent > 95 kg (15 mo)
201	Neg - Neg*	3%	104 kg	93%
39	Neg - Pos*	8%	100kg	77%
76	Pos	43%	90.3 kg	30%

* 1st Test 6-8 mo: all Neg animals retested at 12-15 mo

Contribution Serodiagnosis could make at the herd level

- Removal of 'shedder' animals - Reduce spread of *Map*
- Removal of 'subclinicals' - Minimise production losses
- Accelerate removal of 'susceptible' animals
- Increase proportion of 'resistant' animals
- **Diagnostics will reduce disease prevalence, but may not eradicate infection**

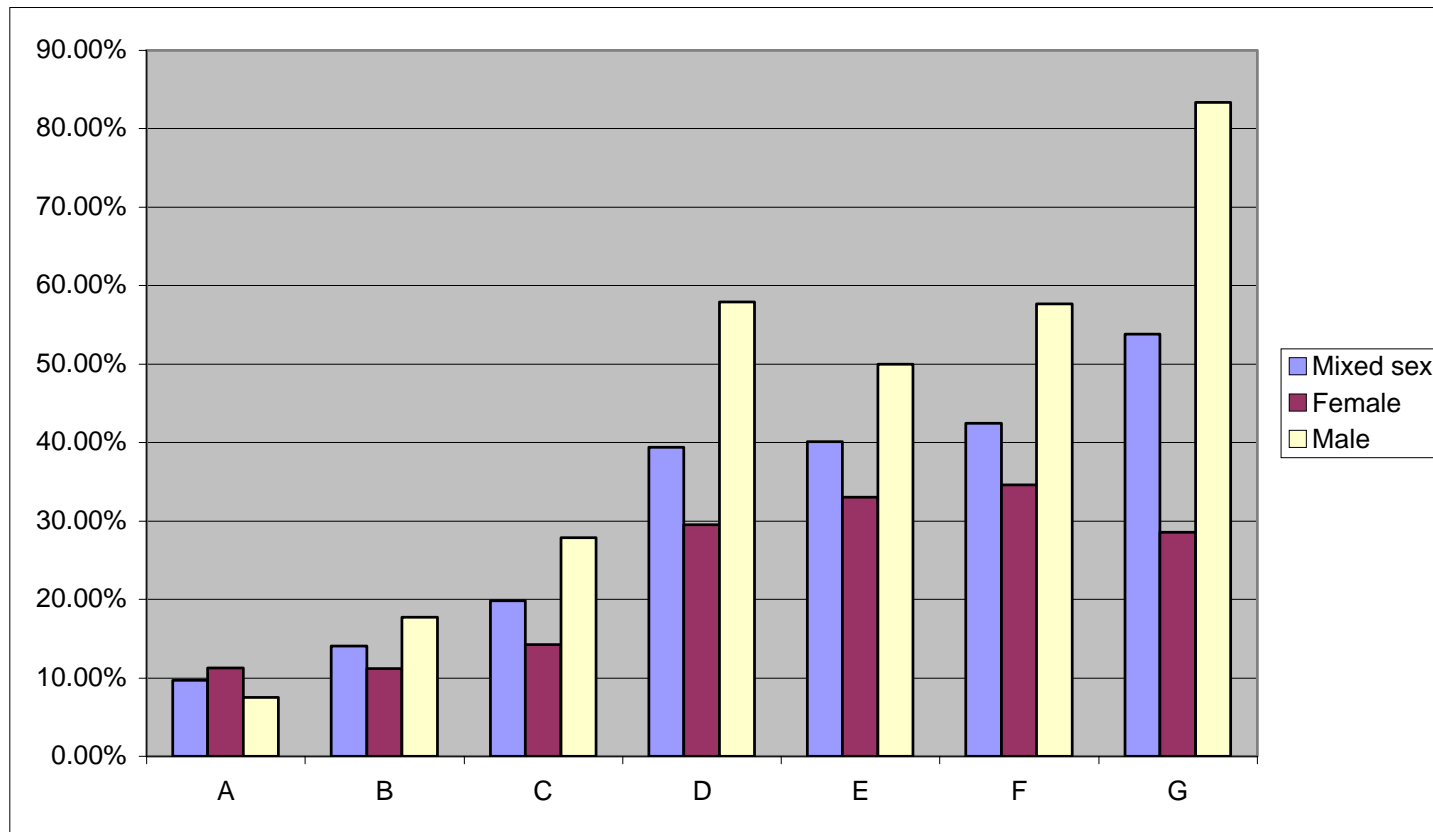
Rates of seroreactivity in herds with a PLAN



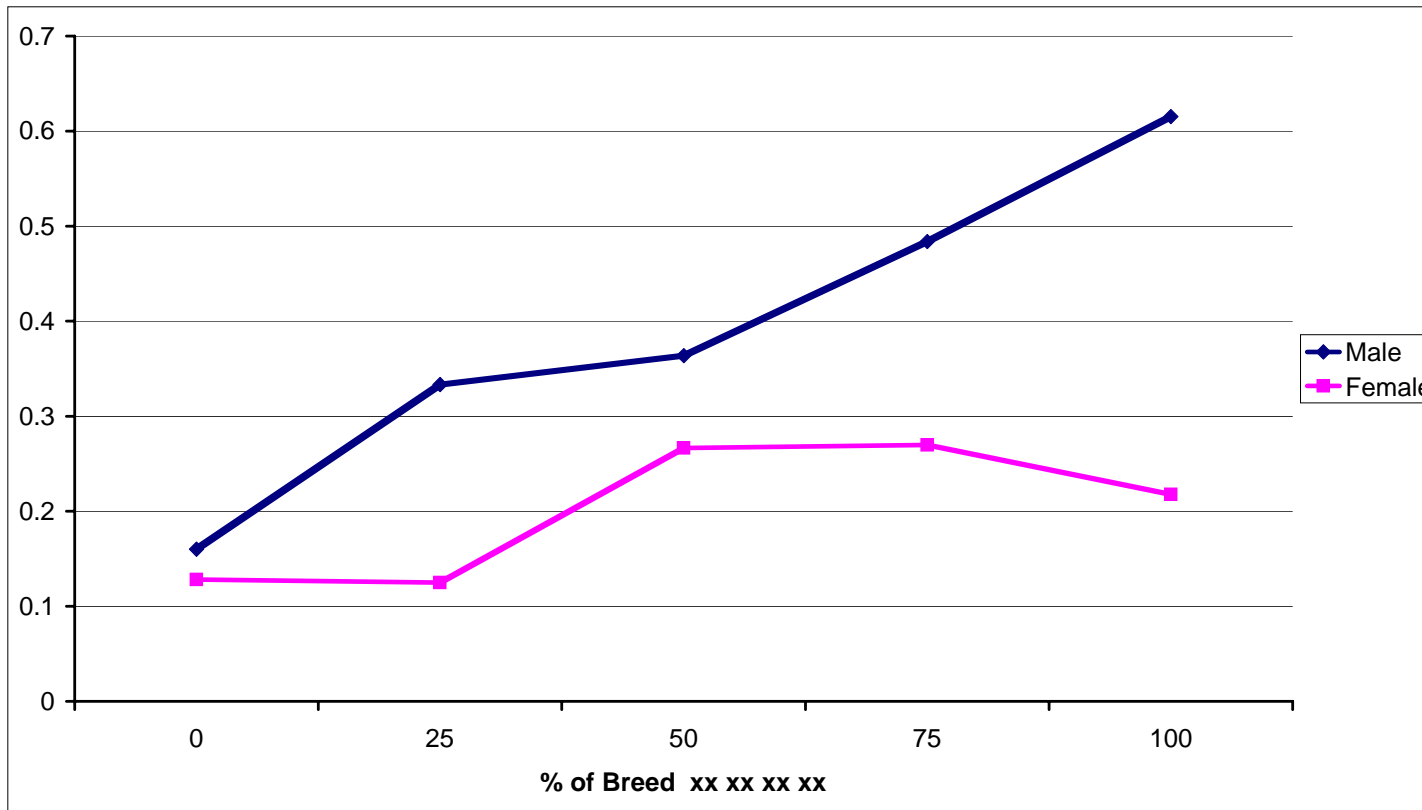
Whimsical observations !!!

The Genome

Deer Breed (A - G) effects on resistance

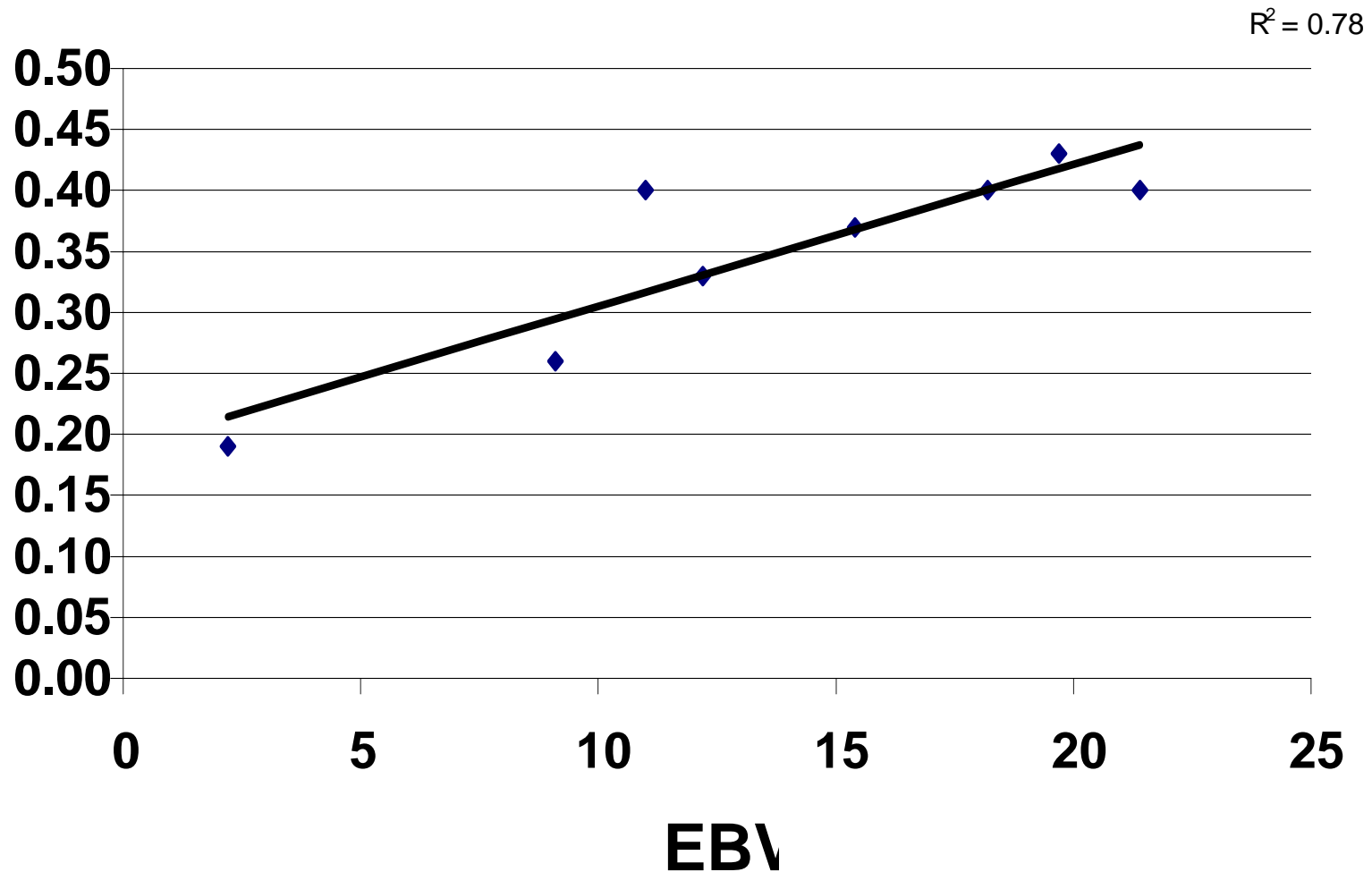


The Phenome



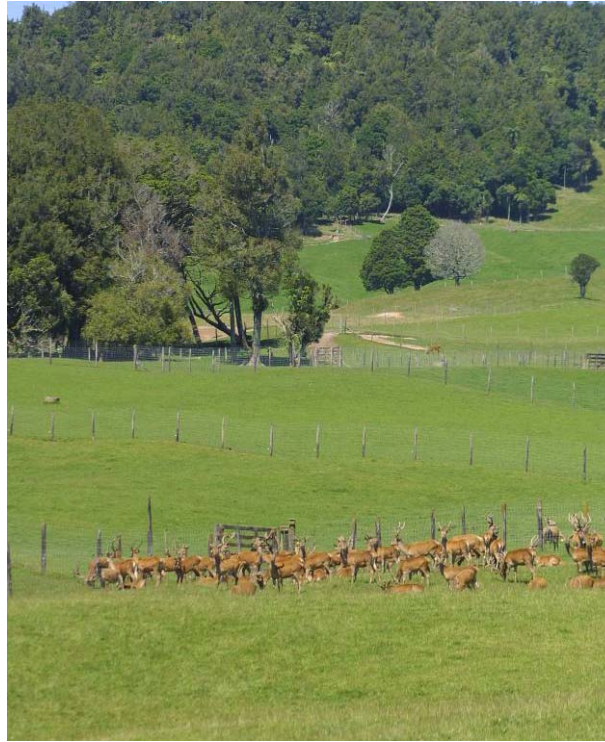
The Physiome

Relationship between reactor rate and breeding values



Conclusions ! Take Home SIX PACK

- ***Map* infection likely affects >50% of NZ Deer herd and > 10% of animals within most infected herds. Probably similar to NZ Dairy herds.**
- ***The Iceberg Effect: Majority of Map* infections do not cause overt Johne's disease (Pathology/ Clinical symptoms)**
- Deer develop more 'florid' cases of **Johne's, than cattle or sheep**, and could be more amenable to diagnosis **than infection in cattle or sheep.**
- **Johnes may be the most, important & underestimated, infectious threat to primary farm production profitability in NZ.**
- **Host genes for Immune Responsiveness and Production Traits may significantly affect disease susceptibility.**
- **Should the link with Crohn's Disease become more credible, NZs Red meat and dairy products may be at SERIOUS RISK !**



Acknowledgements:

Farmers and Veterinarians - field support

Douwe Bakker - Lelystad - PPDj

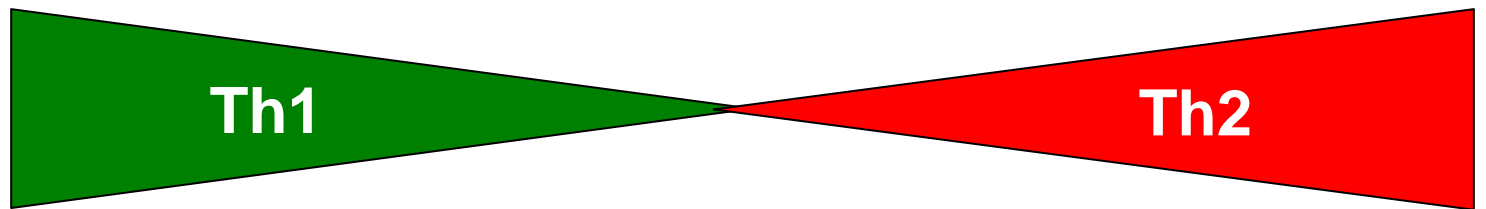
John Bannantine - NADC, Iowa - r-Proteins

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Gary Clark - Histopathology

FoRST NZ - Financial support

The Diagnostome: Diagnosis across the Infectious spectrum



Exposure

Immunity

Infection

Disease

(Vaccination)

(Diagnostics)

(Resistance)

(Susceptibility)