



Spatial coverage of New Zealand dairy herds in a targeted survey for *Mycoplasma bovis*-like clinical disease

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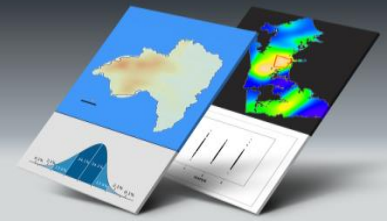




Massey University campus



EpiCentre



The EpiCentre is a **world leader** in veterinary epidemiology training and research.

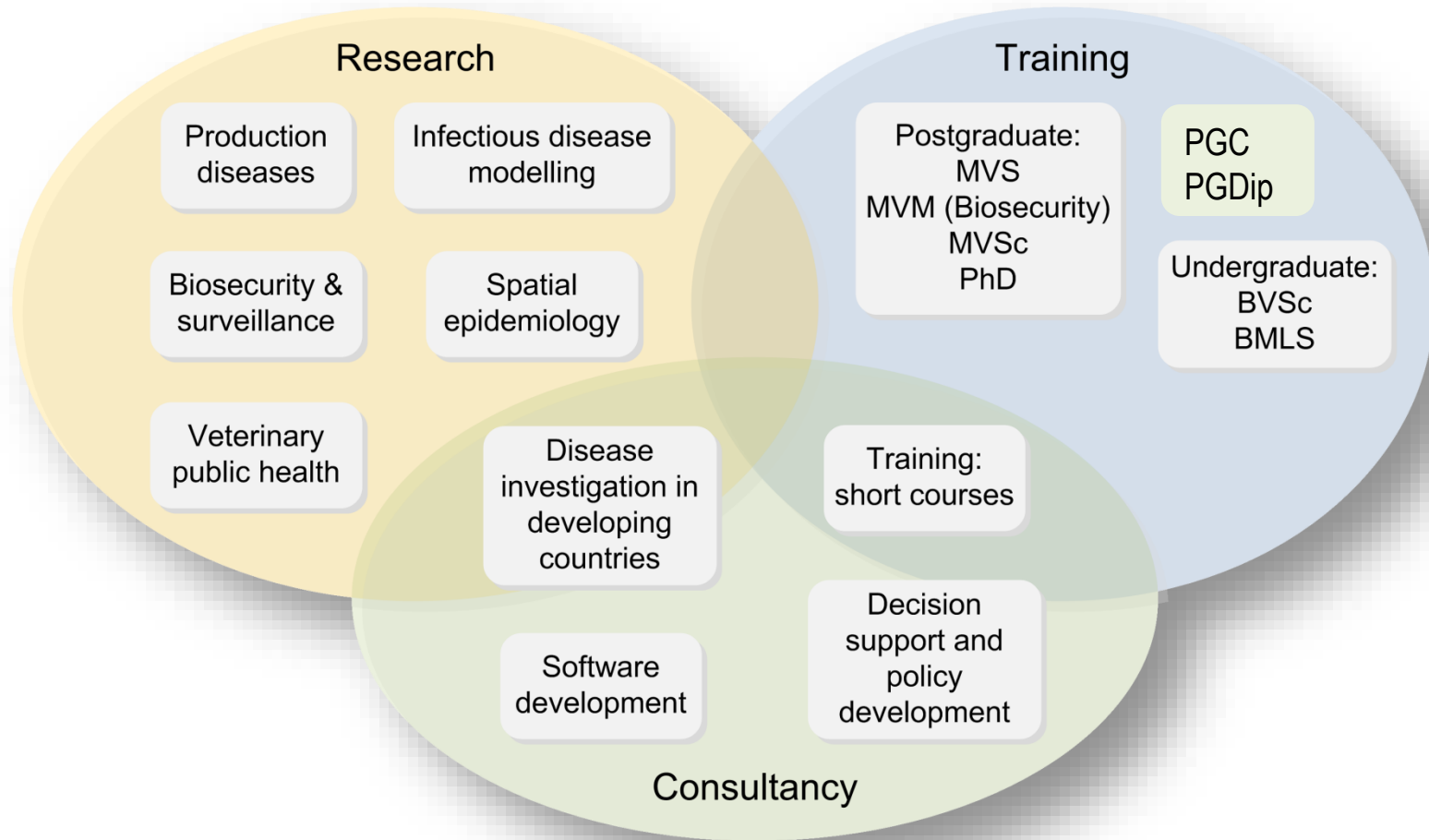
The group has a commitment to using epidemiology to develop practical **solutions** to complex **real-world** problems.



EpiCentre

- Estab. 1992
- Research centre within School of Vet Science
- 7 staff (incl. 1 post-doc)
- 7 PhD students





Research outputs and partners

- Extensive **publication** record (>600) in leading international peer-reviewed scientific journals
- Strong track record of development of **software** tools for analysis, surveillance and decision support
- **Collaborations** with other well-known institutions, e.g. DEFRA, FAO, OIE, WB, EU, Yale U, Cornell U, Glasgow U., Sydney U., Utrecht U., FLI-Germany, U. Melbourne, Australian AH Lab
- Inf. Dis. Res. Centre + NZ Food Safety Science & Research (Massey)
- 2012 OIE-CC Veterinary Epidemiology and Public Health
- 2015 OIE-CC partner with CAHEC (Qingdao, China)
- 2016 Proposal to involve CADCC (Beijing, China) in the partnership
- ...



Cattle disease detected in NZ for first time

7:59 pm on 25 July 2017

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The Ministry for Primary Industries (MPI) has confirmed a cattle disease never before seen in New Zealand has been detected in a herd on a South Canterbury farm.



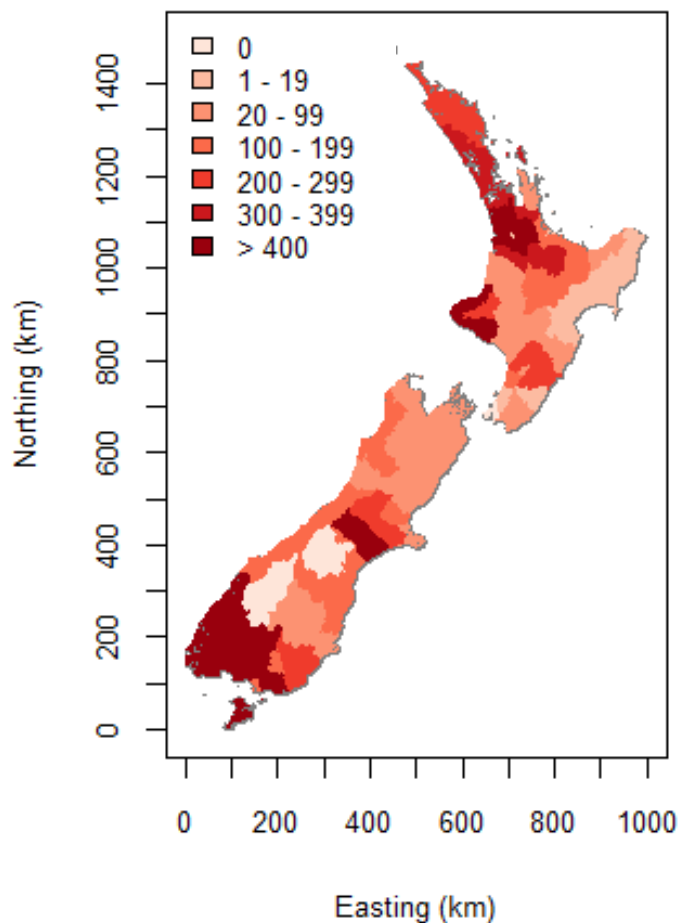


- Spread: milk, all secretions, semen (frozen ?), embryos
- Low infective dose
- Persistent infection + intermittent shedding
- Incubation period mean = 1 (1 - 4) days
- Shedding period mean = 8 (2 - 12) days
- Clinical expression varies widely
- Diagnostic tests variable performance
- Increased herd size a risk factor
- **NEW HERD INFECTIONS DUE ANIMAL IMPORT**



NZ dairy herd distribution¹ (count per district)

- 11, 689 herds
- Mean size = 414 cows
- > 90% seasonal-calving, pasture-grazed
- 60% cows & 73% herds in North Island



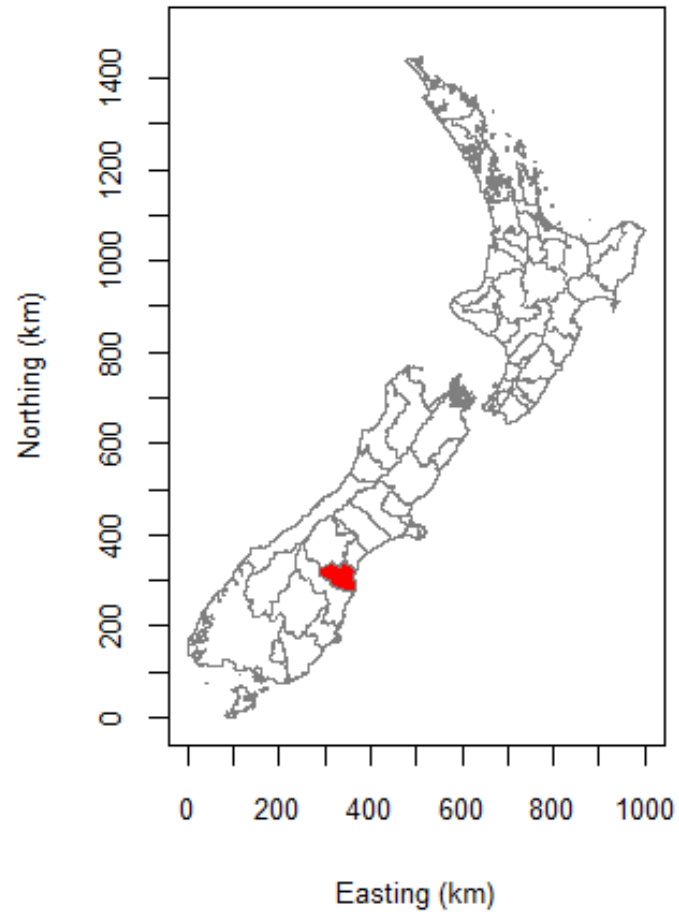
“Tainui” farm – first infected property



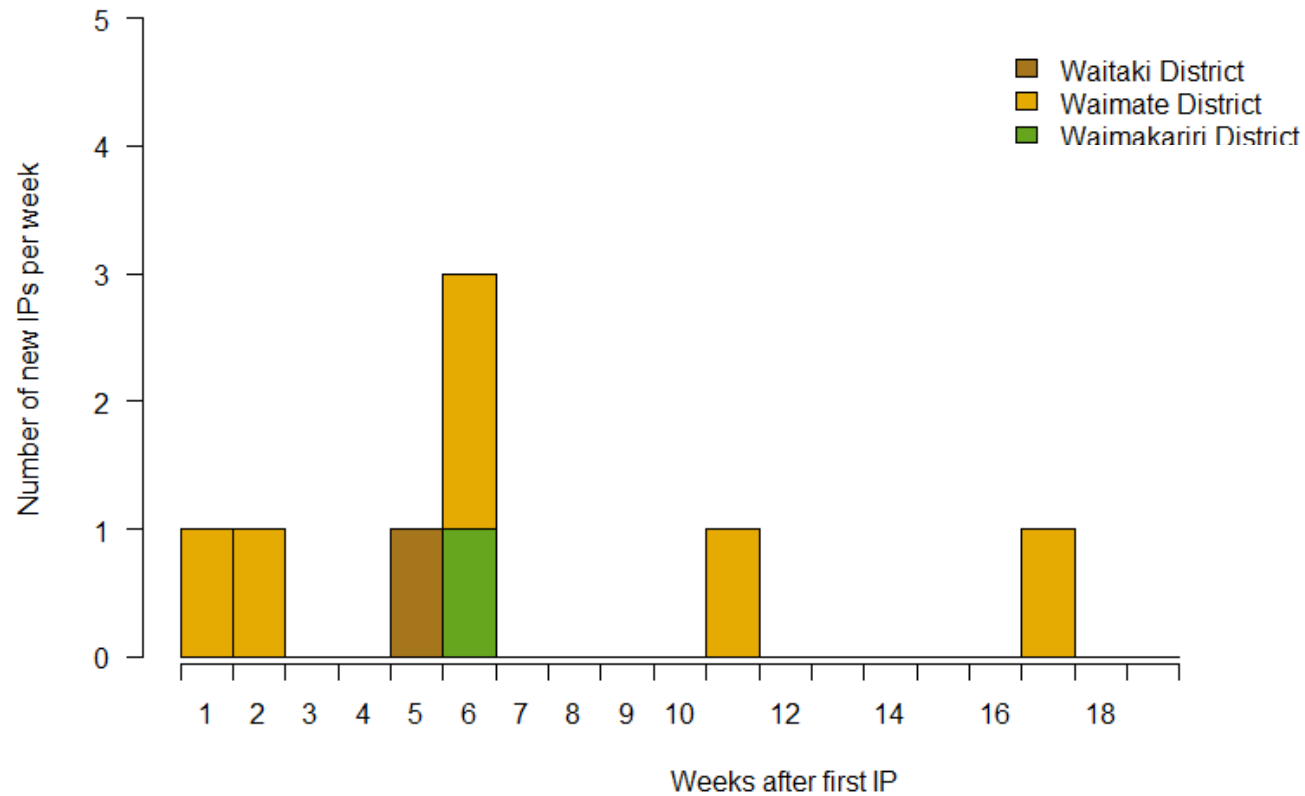
1 of 16 farms in group



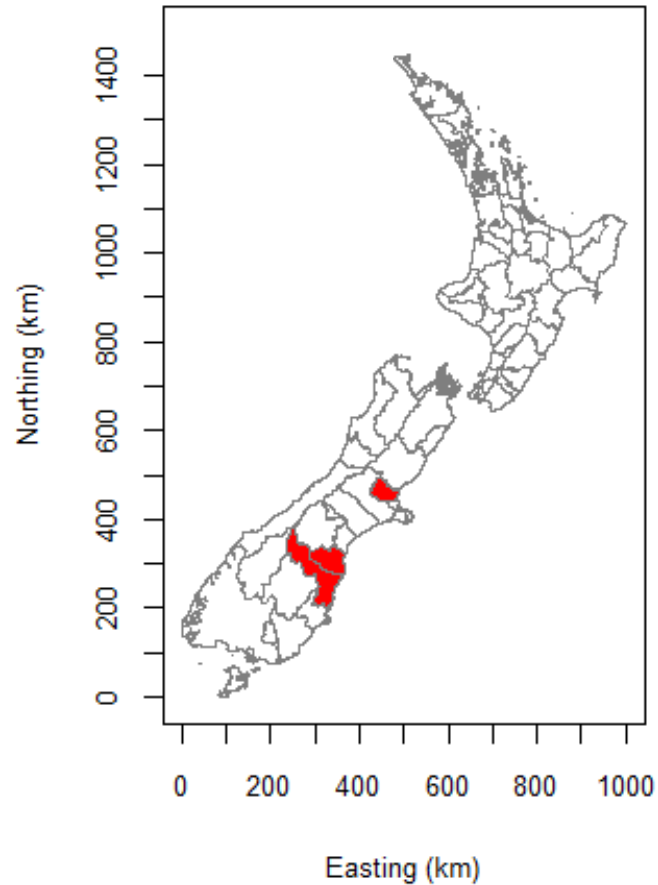
District with first infected property



Epidemic curve Jul-Nov '17



Districts with infected premises Jul- Nov'17



Surveillance systems Aug'17

- Delimiting surveillance
 - The IP farm group properties
 - Contiguous properties
 - Trace contacts
 - Milk survey (2 adjacent districts with IPs)
- Extent of spread (or pre-existence)
 - Exotic disease phone alerts
 - Beef slaughter (2 beef feedlots)
 - National surveys
 - Regional laboratory mastitis milk samples
 - Targeted farm survey – varied sample types



Targeted survey

- Aims
 - Possible spread or pre-existence of clinical *Mb*?
 - Target principal dairy districts
 - **Timely/cost-effective**
- Methods
 - Vet and farmer self-reporting ‘suspect’ herds
 - Vet sampling
- Problems
 - No spatially accurate sampling frame
 - Likely biases- **selection**, misclassification



Suspect case definition for targeted farm survey

Table 1. Farm-level risk criteria of observed or recorded clinical findings during the past 6 months

| Observations over the last 6 months | Risk score (out of 10) |
|---|------------------------|
| Therapy-resistant mastitis (re-diagnosed or re-treated within 30 days of first treatment), in >20% of all mastitis cases on the farm at that time | 10 |
| Multiple-quarter mastitis, in >30% of all mastitis cases on the farm at that time | 6 |
| Severe pneumonia in cattle or calves: >2 cases at any given time | 8 |
| Severe, therapy-resistant conjunctivitis in calves, that is not red-eye, in >5% of the calf group | 8 |
| Head-tilt or otitis media in calves: >2 cases at any given time | 8 |
| BTM-SCC >400,000 at 3 or more collections during the last season | 2 |
| Cows with SCC >500,000 cells/ml: >12% of cows at last herd test | 4 |
| Elevated usage of lactating cow IML or parenteral mastitis therapy of >20% compared to spring last year | 4 |

Suspect = composite score ≥ 10



Data requirements

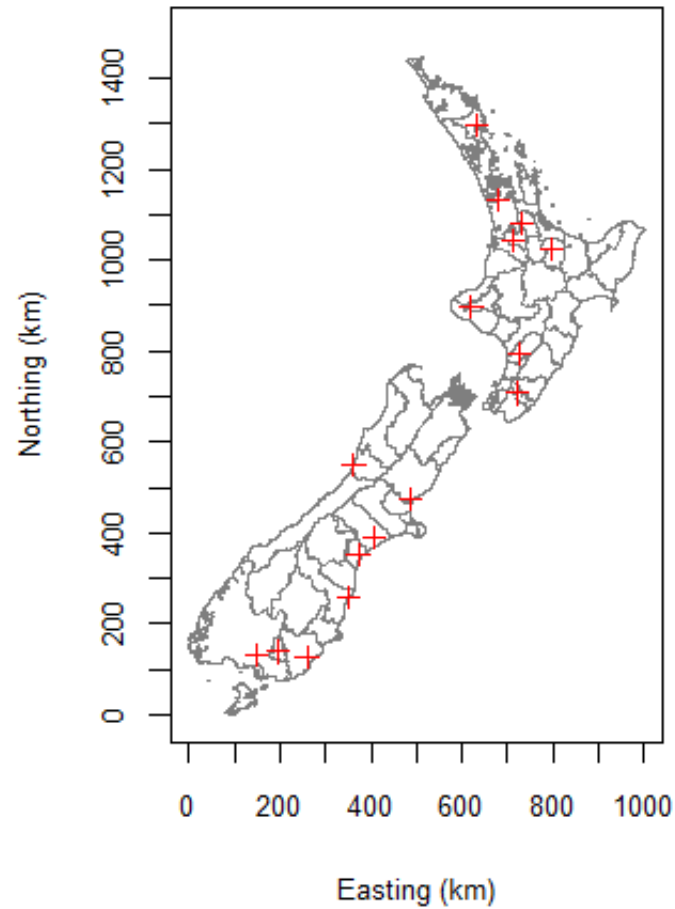
- Population census by district
- Shape file of district boundaries
- Geographic location of vet businesses
- Date and district of new IPs

Table 3.1: Herd analysis by region in 2016/17

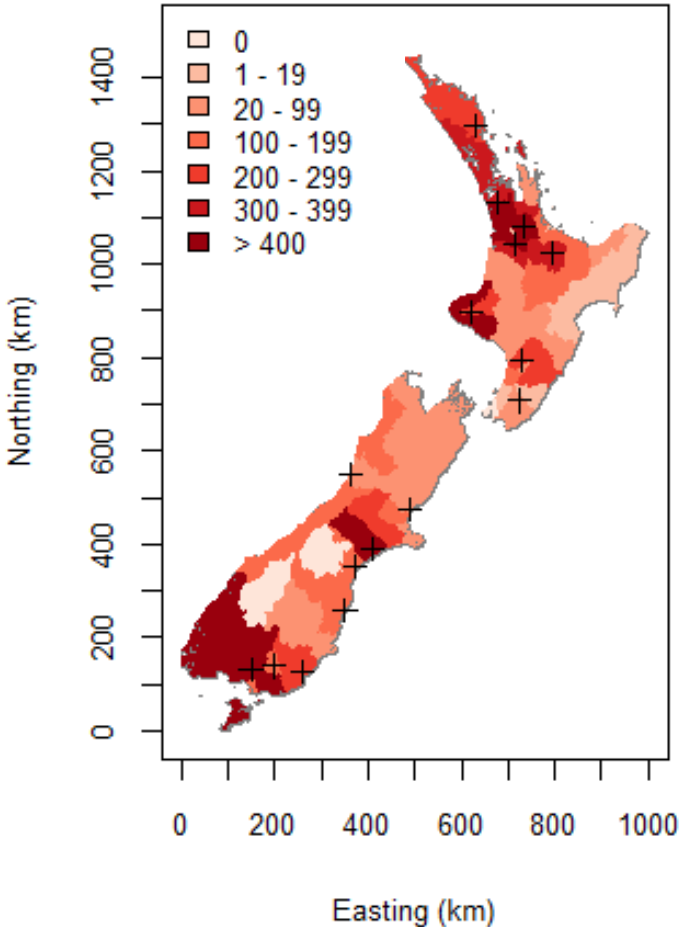
| Farming region | Total herds | Percentage of herds | Total cows | Percentage of cows | Total effective hectares | Percentage of effective hectares | Average herd size | Average effective hectares | Average cows per hectare |
|---------------------|---------------|---------------------|------------------|--------------------|--------------------------|----------------------------------|-------------------|----------------------------|--------------------------|
| Northland | 882 | 7.5 | 269,123 | 5.5 | 120,661 | 7.0 | 305 | 137 | 2.23 |
| Auckland | 395 | 3.4 | 104,425 | 2.1 | 43,549 | 2.5 | 264 | 110 | 2.40 |
| Waikato | 3,379 | 28.8 | 1,117,411 | 23.0 | 383,280 | 22.2 | 331 | 113 | 2.92 |
| Bay of Plenty | 576 | 4.9 | 191,491 | 3.9 | 68,808 | 4.0 | 332 | 119 | 2.78 |
| Central Plateau | 486 | 4.1 | 271,083 | 5.6 | 100,452 | 5.8 | 558 | 207 | 2.70 |
| Western Uplands | 87 | 0.7 | 44,129 | 0.9 | 18,045 | 1.0 | 507 | 207 | 2.45 |
| East Coast | 9 | 0.1 | 5,976 | 0.1 | 2,155 | 0.1 | 664 | 239 | 2.77 |
| Hawkes Bay | 73 | 0.6 | 45,687 | 0.9 | 16,754 | 1.0 | 626 | 230 | 2.73 |
| Taranaki | 1,657 | 14.1 | 473,110 | 9.7 | 170,062 | 9.8 | 286 | 103 | 2.78 |
| Manawatu | 542 | 4.6 | 212,816 | 4.4 | 78,305 | 4.5 | 393 | 144 | 2.72 |
| Wairarapa | 443 | 3.8 | 160,675 | 3.3 | 58,572 | 3.4 | 363 | 132 | 2.74 |
| North Island | 8,529 | 72.6 | 2,895,926 | 59.6 | 1,060,643 | 61.4 | 340 | 124 | 2.73 |
| Nelson/Marlborough | 228 | 1.9 | 85,153 | 1.8 | 29,859 | 1.7 | 373 | 131 | 2.85 |
| West Coast | 379 | 3.2 | 155,655 | 3.2 | 69,723 | 4.0 | 411 | 184 | 2.23 |
| North Canterbury | 873 | 7.4 | 672,398 | 13.8 | 199,288 | 11.5 | 770 | 228 | 3.37 |
| South Canterbury | 311 | 2.6 | 232,678 | 4.8 | 71,814 | 4.2 | 748 | 231 | 3.24 |
| Otago | 439 | 3.7 | 256,497 | 5.3 | 88,242 | 5.1 | 584 | 201 | 2.91 |
| Southland | 989 | 8.4 | 563,017 | 11.6 | 209,133 | 12.1 | 569 | 211 | 2.69 |
| South Island | 3,219 | 27.4 | 1,965,398 | 40.4 | 668,059 | 38.6 | 611 | 208 | 2.94 |
| New Zealand | 11,748 | | 4,861,324 | | 1,728,702 | | 414 | 147 | 2.81 |



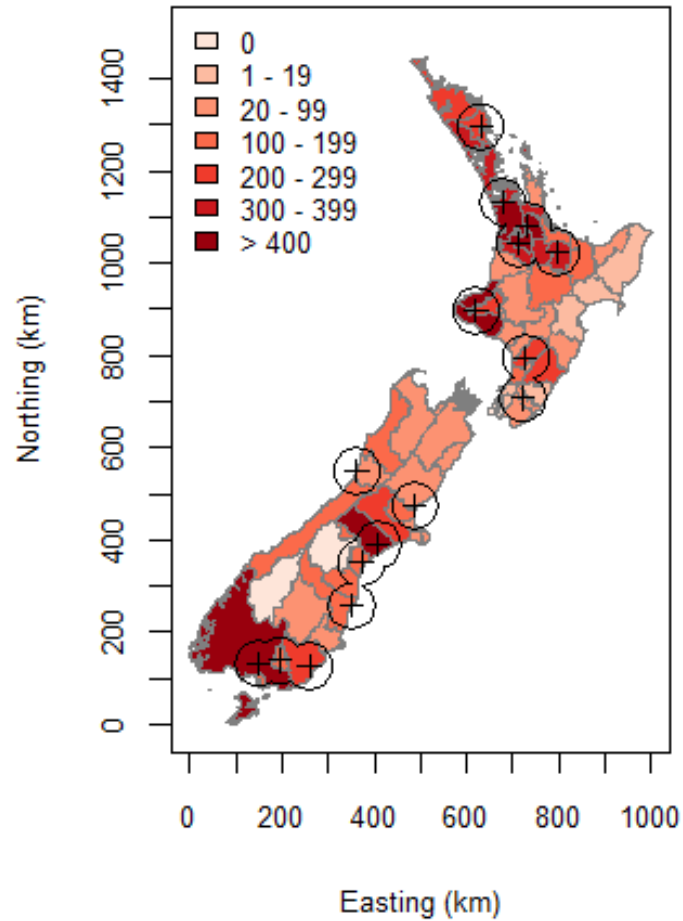
Enrolled vet locations (n = 16)



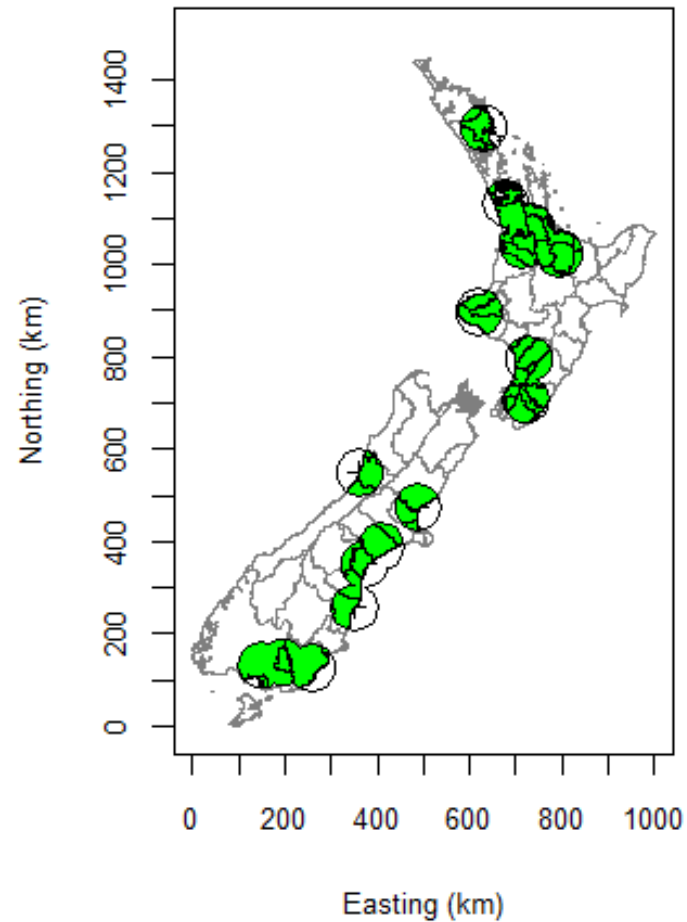
Choropleth map of count of herds per district (vet practices marked +)



Buffer (r = 50 km) area around vet locations



Coverage of targeted survey (shaded green)



Survey coverage of all farms

1. Define buffer zone around vet (50 km radius)
2. Estimate area of district within buffer (buffArea_i)
3. Estimate area of entire district (distArea_i)
4. Calculate %age of district within buffer

$$\text{coverage}_i = \frac{\text{buffArea}_i}{\text{distArea}_i}$$

5. Calculate count of herds within buffers (with assumptions)

$$\text{nHerdsCovered} = \sum_i^{n=62} \text{coverage}_i \times \text{nHerds}_i$$

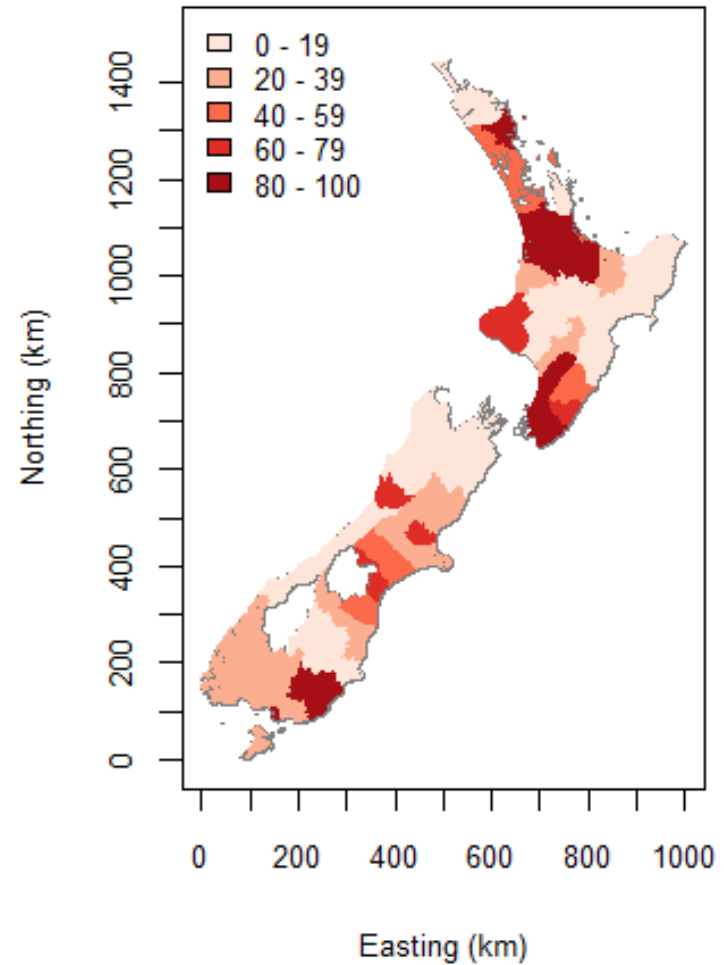
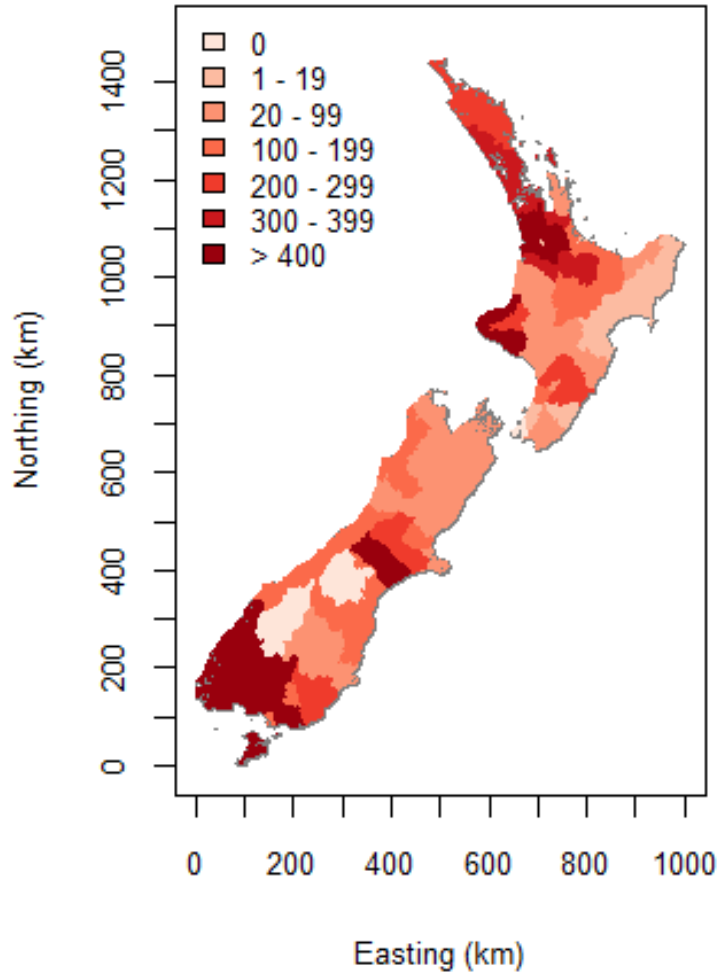


Survey coverage of all farms

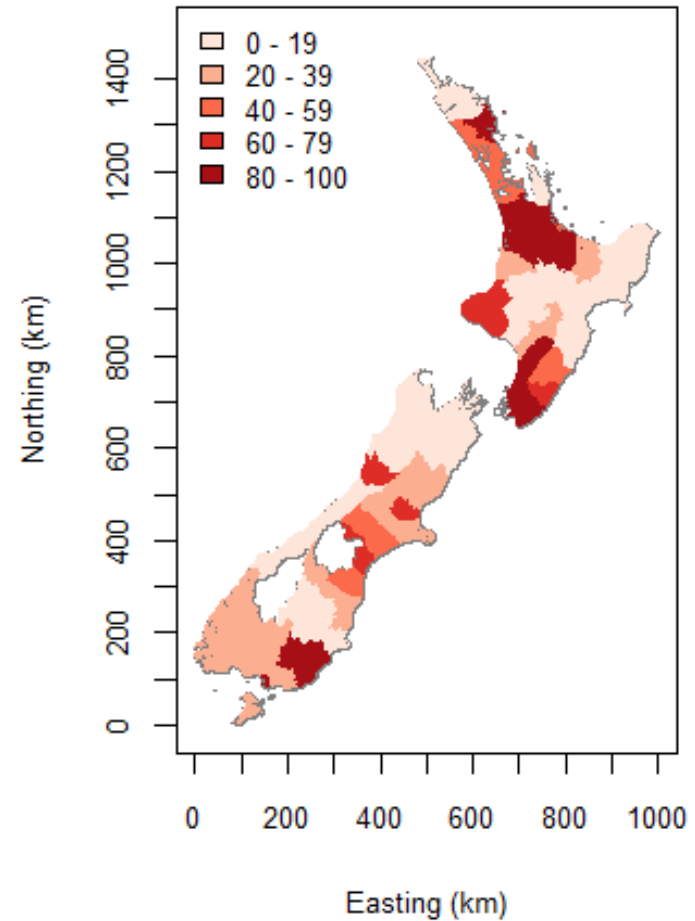
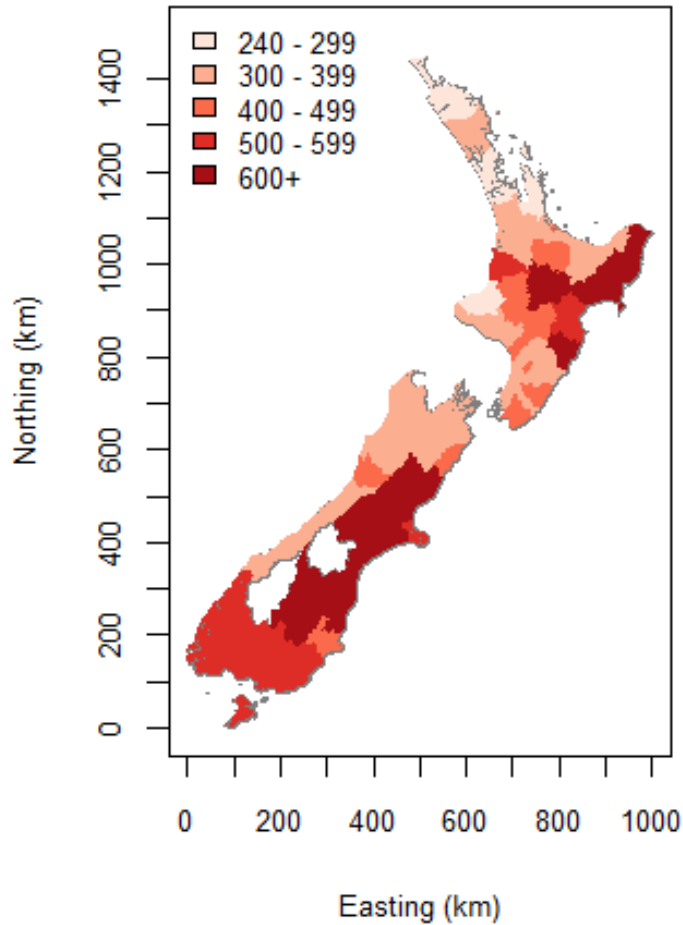
7. Total coverage (%) = $\frac{n\text{HerdsCovered}}{n\text{Herds}} \times 100 = 68\%$
8. Map district coverage



District herd population vs. coverage %



Mean district herd size vs. coverage %

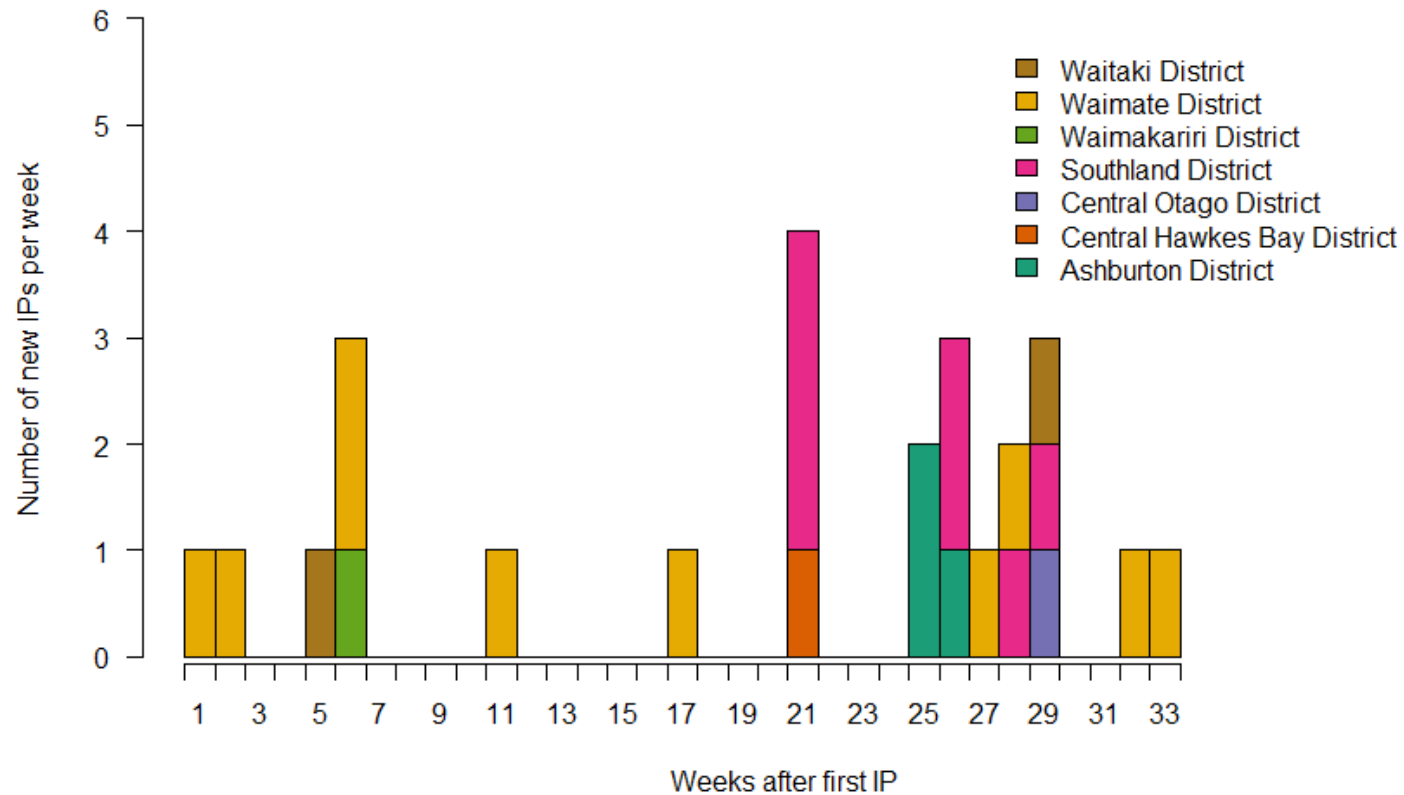


Targeted farm survey results

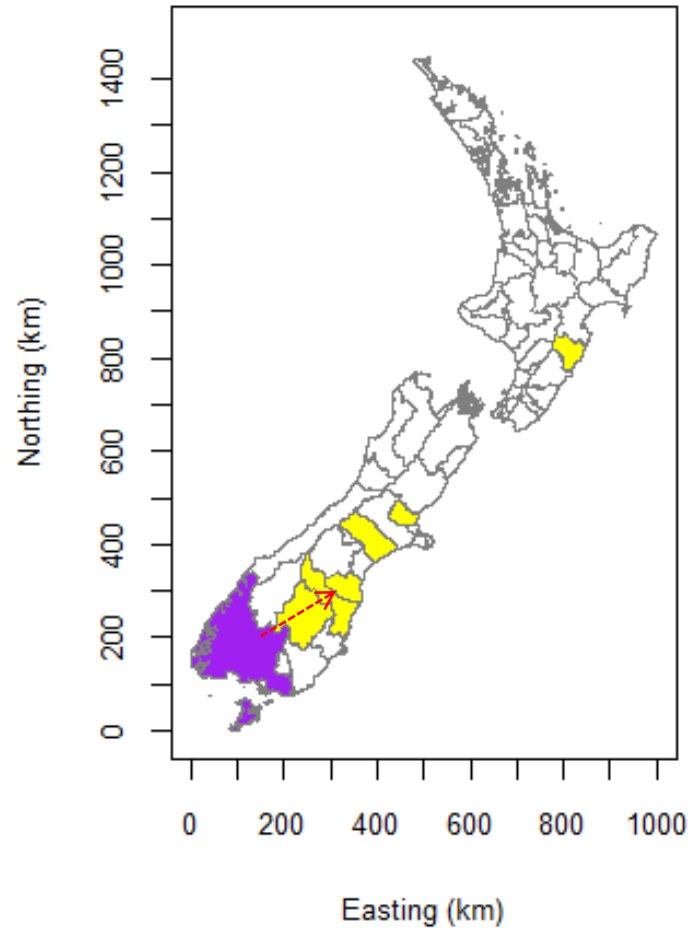
- 40 vets from 16 practices in all but 2 districts enrolled
- Mastitis-related reasons important
- 93 farms had samples collected
 - 1,511 samples
- 380 farmers returned survey data
 - 12 farms “suspect”
- NO samples positive for *Mycopl. bovis*



Epidemic curve Jul-Mar '18



Southland cluster of IP's (purple)



Use of GIS in targeted survey

- Inform surveillance systems
 - Qualitative estimate of coverage
 - Used to estimate probability of FFD
- Enhanced communication to decision-makers



Outbreak summary

- Only first IP detected from clinical symptoms
- Poor farmer compliance with recording animal movements
- Poor awareness by farmers/vets of exotic diseases & biosecurity
- Source of incursion not identified...
- Key decisions by Apr '18



Questions, comments?

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