Massey University

Application of GIS and Landscape Epidemiology to TB Control in Possums

Joanna McKenzie[1], Roger Morris[1], Dirk Pfeiffer[2], Jim Lambie[3], Diederik Meenken[3]

[1]EpiCentre, IVABS,Massey University
[2] Royal Veterinary College, University of London
[3]Greater Wellington Regional Council

Te Kunenga ki Pūrehuroa

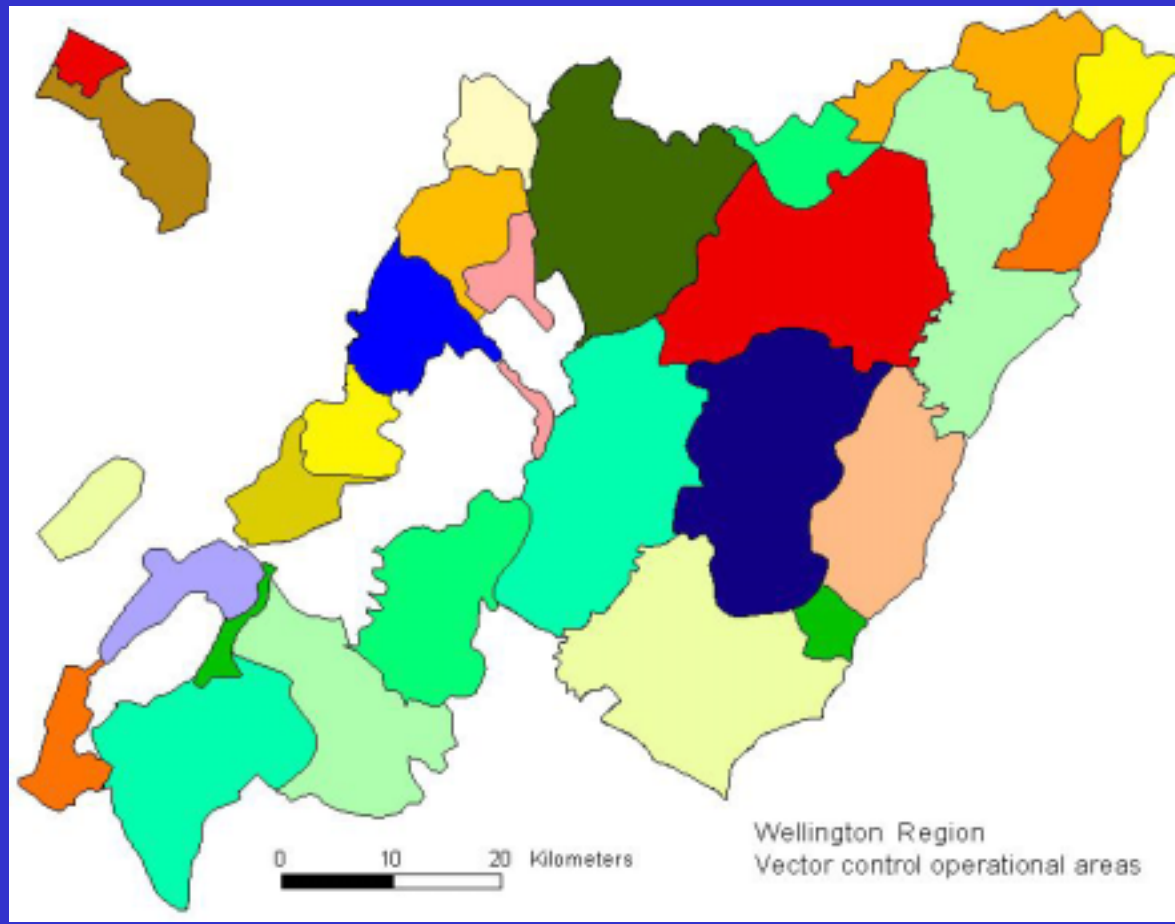
Research Programme

- Investigate applications of satellite-derived habitat data and GIS to facilitate risk-based control of TB in possums
  - Possum TB clusters (hot spots)
  - Possum clusters
  - Farm-level environmental risk factors for TB possums

Possums are wildlife vectors for TB in New Zealand

Eradication of TB from possums

- Annual control for ~7 years to eradicate TB
- Intensity of control consistent throughout 10-30,000 Ha areas
- Monitoring after operation to measure residual possum population
- ~$50M per year spent on possum control



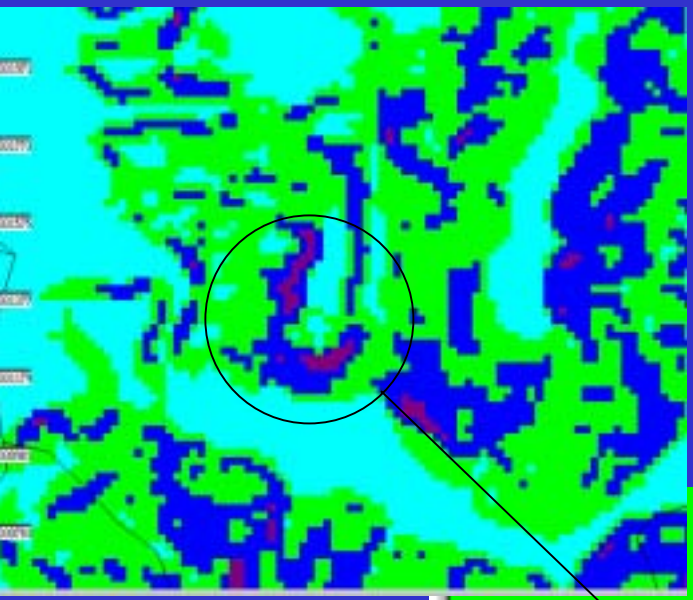
Massey University

Predicting possum TB clusters

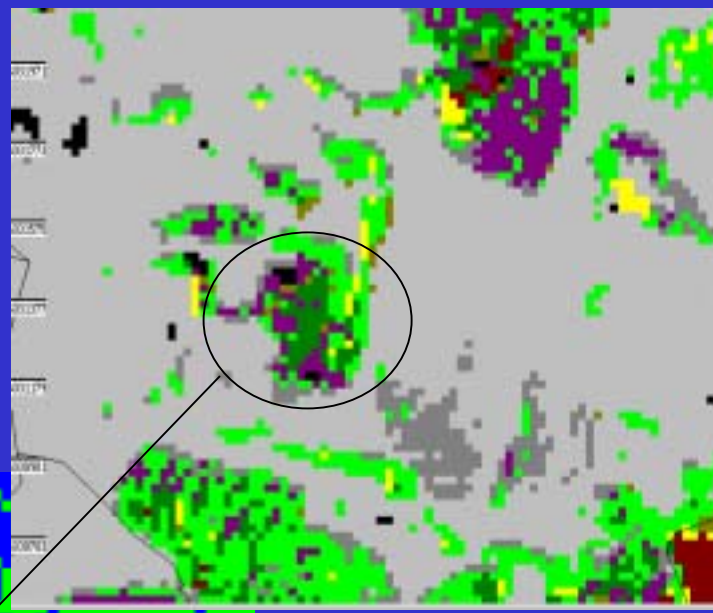
- Detailed field study to identify environmental risk factors
  - Multiple enclosed dens
  - Slope <10^{o}
- Model hot spot distribution in a GIS
  - Data (20m pixels)
    - SPOT3 satellite data → 9 veg^{n} classes
    - Slope in 10^{o} categories
  - Multiple enclosed dens inferred from veg^{n} class
  - Rules for 3 risk classes (high, mod, low)

Te Kunenga ki Pūrehuroa

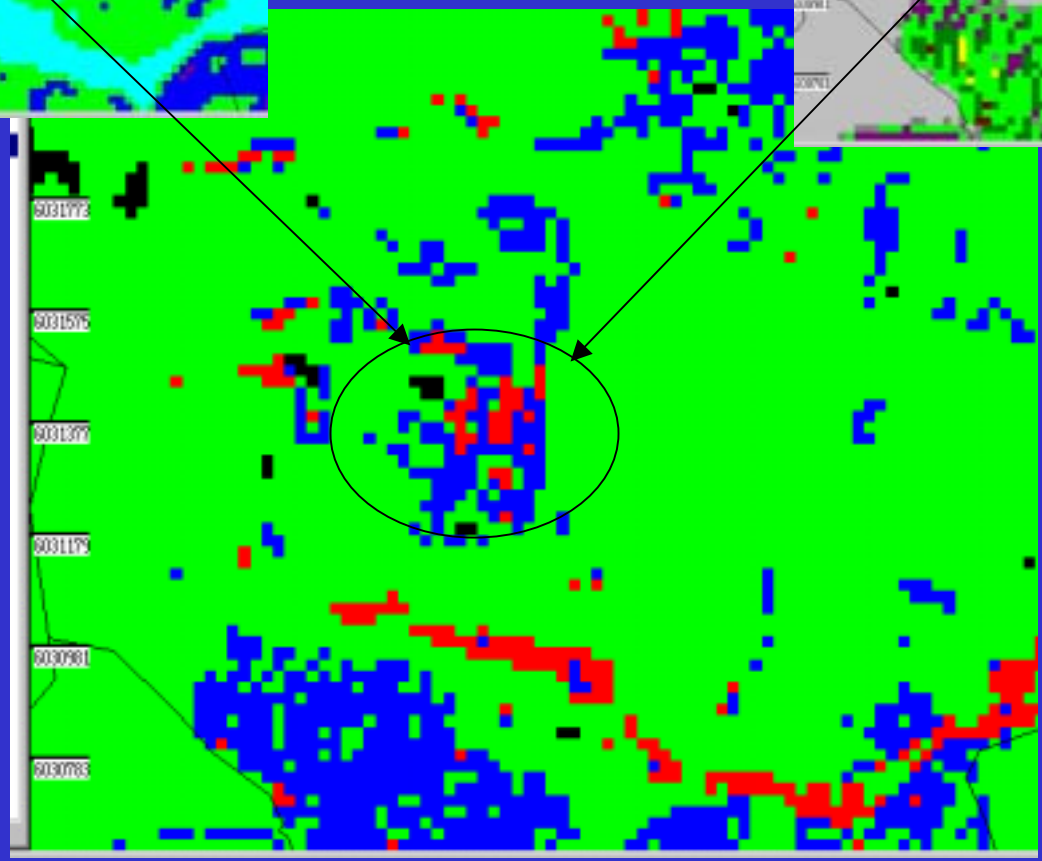
Hot Spot Classification



Slope

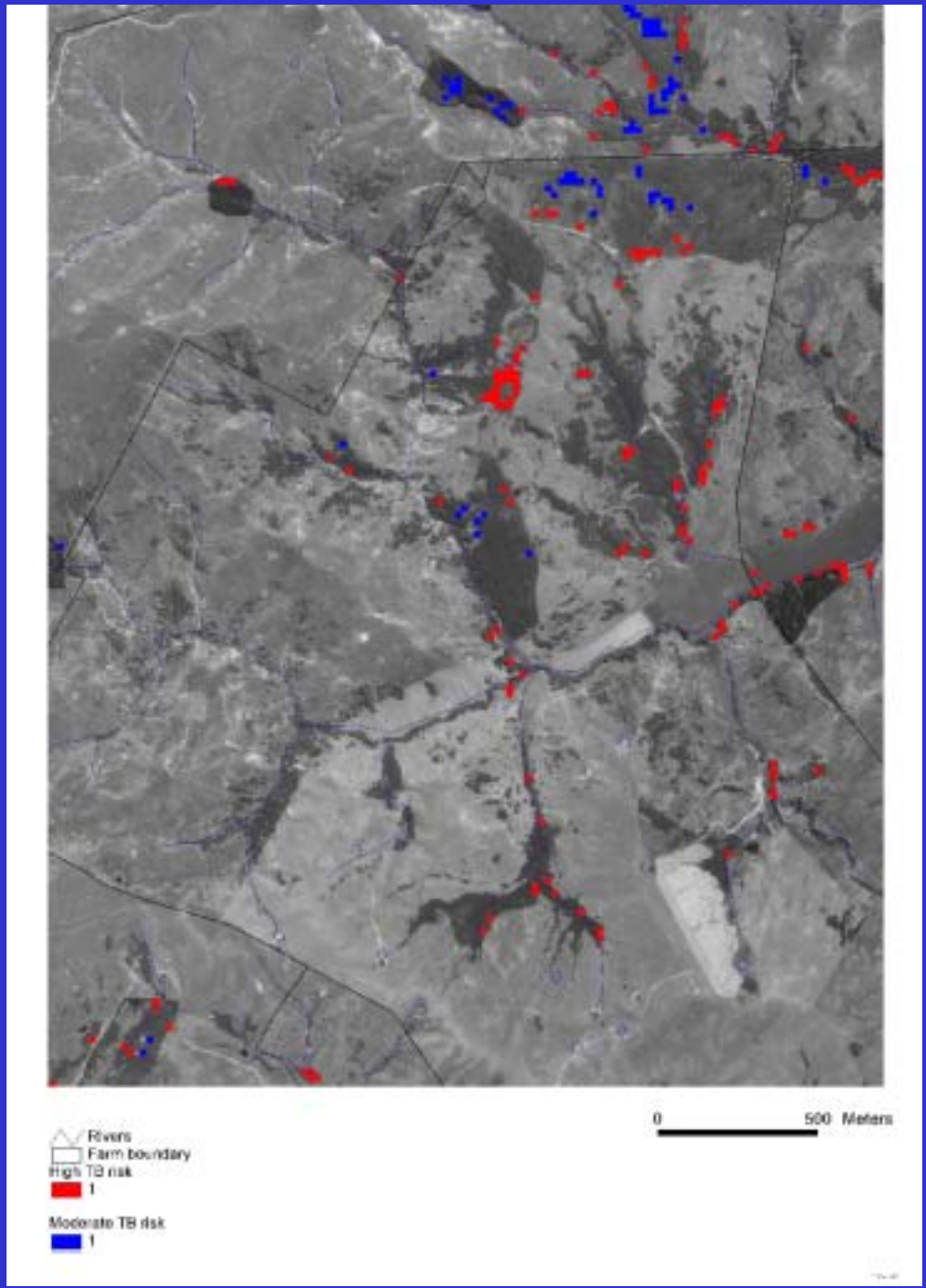


Vegetation



Hot spot risk

Map of predicted hot spots overlaid on an aerial photograph



Validate model

- How well did model predict TB hot spots?
  - Couldn‘t measure distribution of hot spots
- How well did model predict distribution of major risk factor?
  - multiple enclosed dens
- Field testing (60 sites)
  - High-risk: sensitivity of 33% for predicting sites with mult enclosed dens & specificity of 71%
  - High + med-risk: sensitivity of 71% & specificity of 43%

Massey University

Predicting possum clusters

- Detailed study to identify environmental risk factors
  - GPS technology – possum data in digital format
  - Direct analysis of relationship between digital habitat data & possum density

Te Kunenga ki Pūrehuroa

Vegetation data

- SPOT4: 13 classes

Possum data

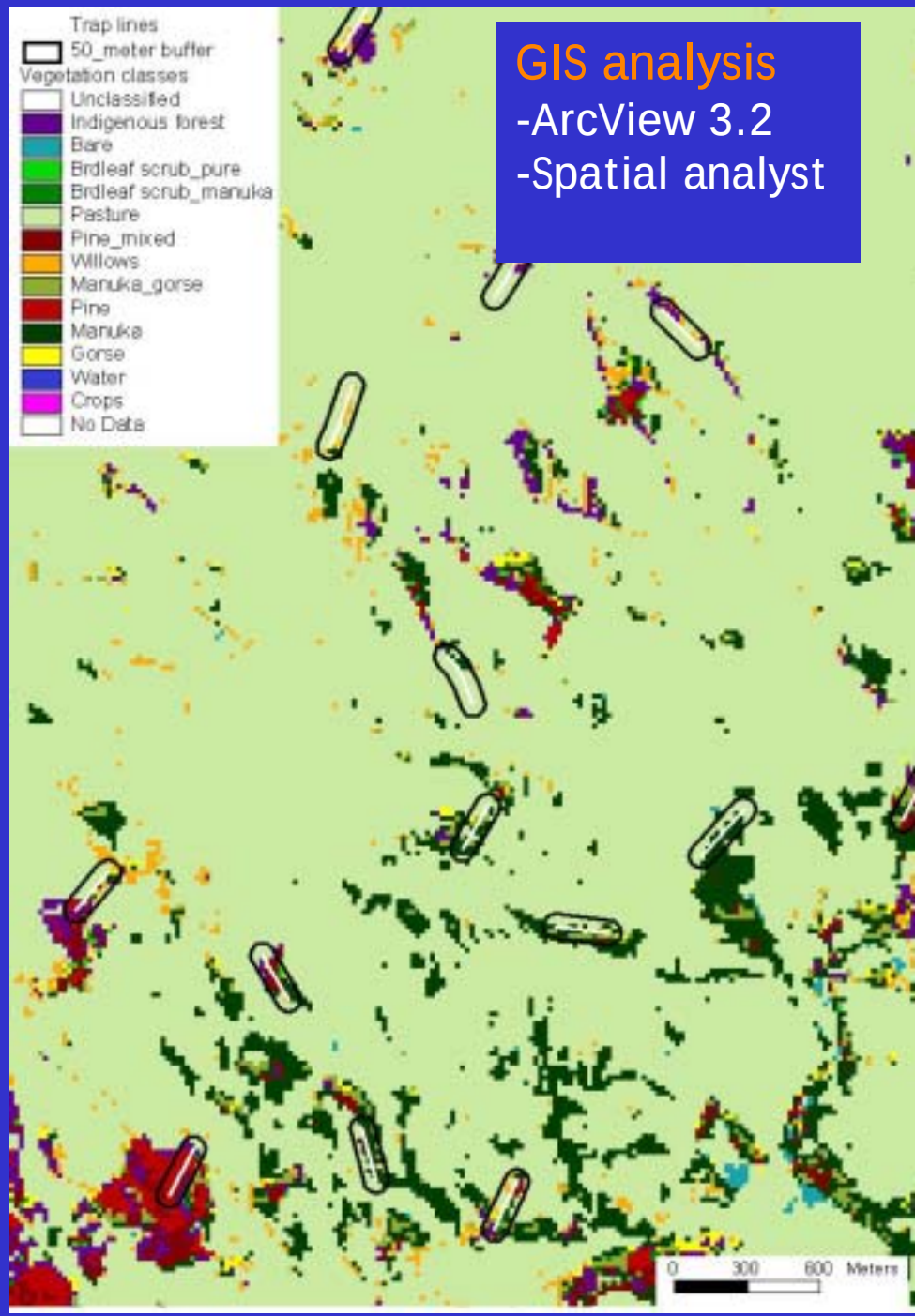
- 200m lines: 10 traps @ 20m spacing

Geographic unit

- 50m buffer around each trap line (3 Ha)

Habitat variables

- Total area non-pasture veg^{n}
- Area each veg^{n} class
- Heterogeneity: # different veg^{n} classes



Massey University

Modelling residual possum distribution

- Generated rules for 2 risk classes based on habitat heterogeneity
- Classified each 3-hectare unit into 2 risk classes (high/low)
- Validated model using original data
- Results:
  - 1.7X possums in high risk cf low risk (p=0.01)
  - 2.4X clusters (>2 possums) in high risk (p=0.09)

Te Kunenga ki Pūrehuroa

Farm-level risk factors

- Data
  - SPOT3 satellite data → 9 veg^{n} classes
  - Agribase – farm boundaries
- Software
  - Fragstats (landscape pattern analysis)
  - ArcView 3.1 + spatial analyst
- Variables
  - Heterogeneity, interspersion, contagion, patchiness
  - Vegetation classes (hectares), distance from forest, length of river, farm size, etc

Results

- Most significant variables were de facto variables for TB possum risk
  - Distance from forest
  - Area of scattered trees (+)
  - Area of podocarp forest (-)
- Alternative models using landscape variables showed heterogeneity as sig.
- Variables very area-specific

Conclusions 1

- Possum TB hot spots
  - Identified significant environmental predictors of hot spots
  - Unable to accurately model hot spot risk in GIS because digital land cover data didn't accurately capture important risk factor (multiple enclosed dens)

Conclusions 2

- Possum distribution
  - Possums are habitat generalists - difficult to identify accurate environmental predictors of distribution
- A challenge to geographic modelling using land cover classes
  - Particular habitats that capture the risk factors (e.g. multiple dens, heterogeneity) vary between regions
  - Need to identify high-risk land cover classes specific to each region

Conclusions 3

- More accurate detailed land cover data becoming available
  - e.g. removal of topographic effects
- Becoming more widely used in NZ – people more comfortable with the technology
- Modelling may be more useful as TB control progresses & more tools needed to control residual problem areas

Massey University

Acknowledgment

- This research has been funded by the Animal Health Board of New Zealand

Te Kunenga ki Pūrehuroa