Tools for developing cost-effective decisions for managing invasive pest eradications

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CENTRE FOR INVASIVE SPECIES SOLUTIONS

Partners/Collaborators

- Collaborators
  - Michael Scroggie – Arthur Rylah Institute
  - Dean Anderson/Andrew Gormley – Landcare Research New Zealand
  - Peter Caley – CSIRO
  - Phill Cassey – Adelaide University

- Partners
  - Department of Jobs Precincts and Regions, Victoria
  - CSIRO
  - Adelaide University
  - Landcare Research New Zealand

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Objectives

- Develop new tools/systems for guiding decisions around an eradication response for invasive pests.
- Improve capability of agencies to make cost-effective decisions around pest eradications by:-
  1. developing a flexible suite of decision support tools using data from active eradication case studies
  2. developing a bioeconomic framework for conducting pest eradication programs
  3. packaging the decision tools and bioeconomic framework into a user-friendly software package that is easily accessible to managers.

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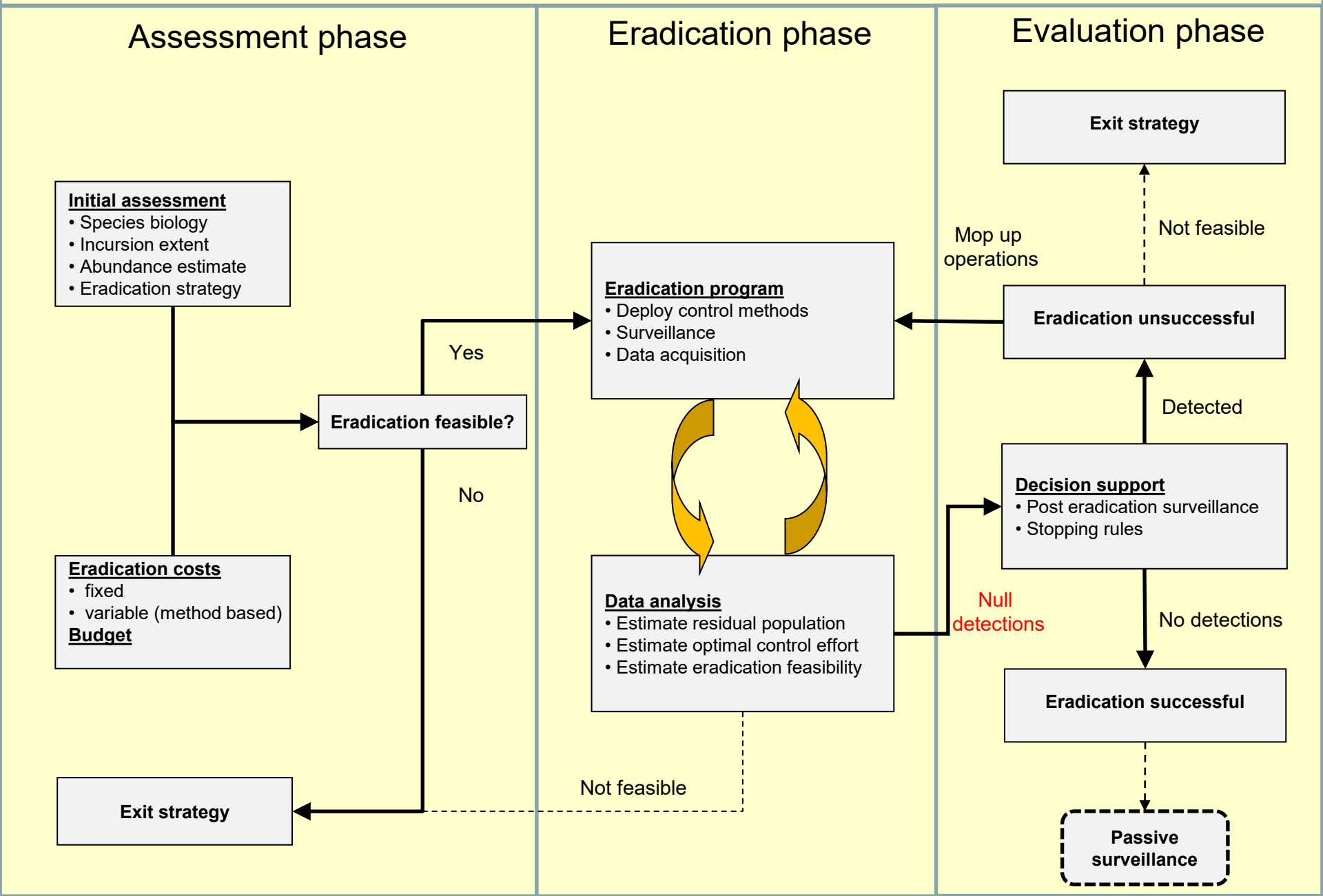
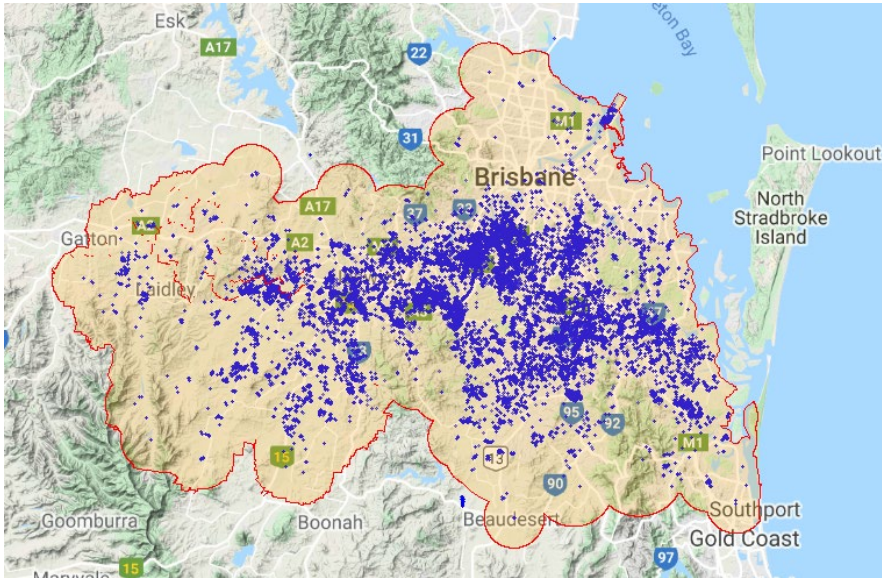
Eradication Response Framework



Initial Assessment Phase

- Objectives
  - Obtain baseline information about the incursion
    - Extent (spatial distribution)
    - Abundance/Occupancy (habitat/risk relationships)
  - Initial eradication feasibility assessment
    - Can pest be eradicated using chosen method(s)?
    - Estimate cost to achieve eradication



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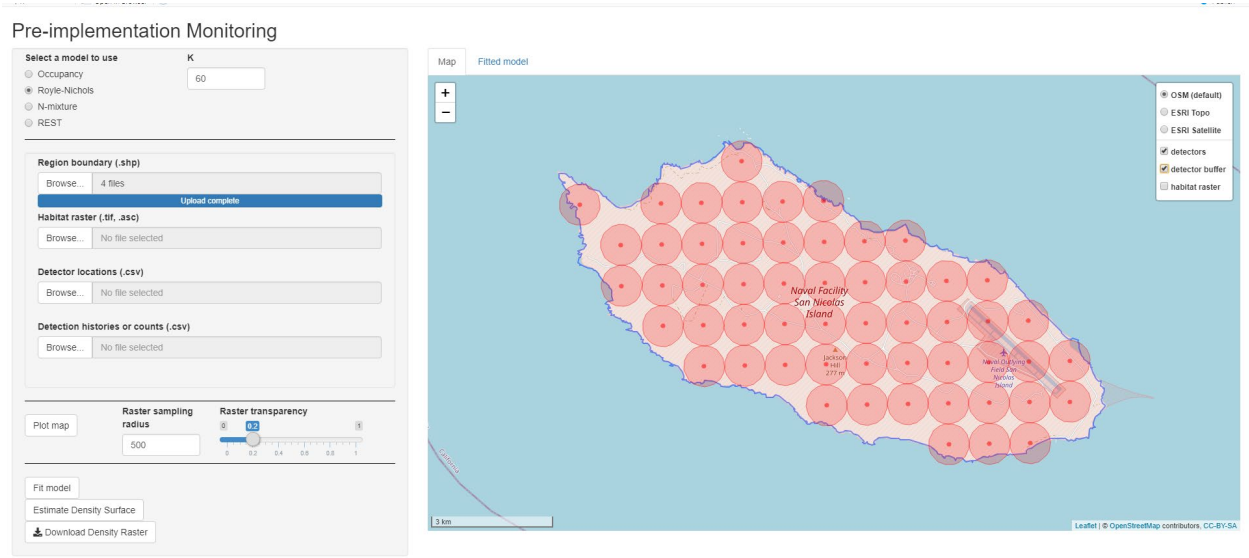
Initial Assessment Phase

- Initial pest abundance and extent
  - Collection of monitoring data
    - Establish sampling frame (region extent, risk layer, sampling units)
    - Monitoring design (detection device layout)
    - Deploy
    - Collate data ⟹ Eradication tools



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Initial Assessment Phase

- Initial abundance estimates – software backend
  - Models
    - N-mixture models – replicate counts of individuals per device/unit
    - Royal-Nichols model – presence/absence data per device/unit
    - Occupancy model – presence/absence data
    - REST model – Time to first detection/staying time (camera data)
  - All models fit by maximum likelihood using custom built R package
    - "eradicate" (https://github.com/eradicate-dev/eradicate)

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Initial Assessment Phase

- Eradication feasibility Tool (Under Development)
  - Assess the feasibility of eradicating the pest incursion
  - Inputs:
    - Initial abundance estimate/spatial distribution
    - Baseline pest removal design - methods/device(s)
    - Unit costs
  - Based on inputs conduct a search for the optimal design that results in eradication for a fixed cost.
  - Alternatively, estimate the likely cost to achieve eradication for the given inputs.

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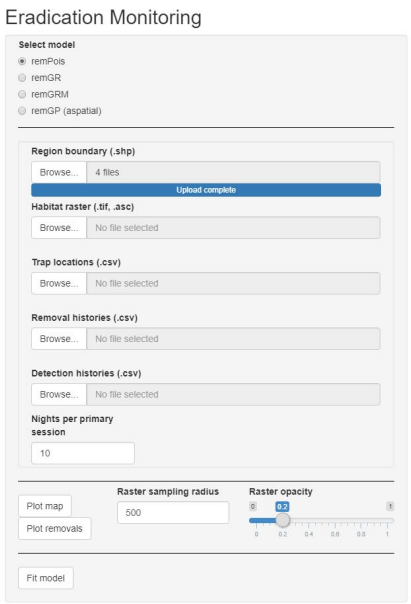
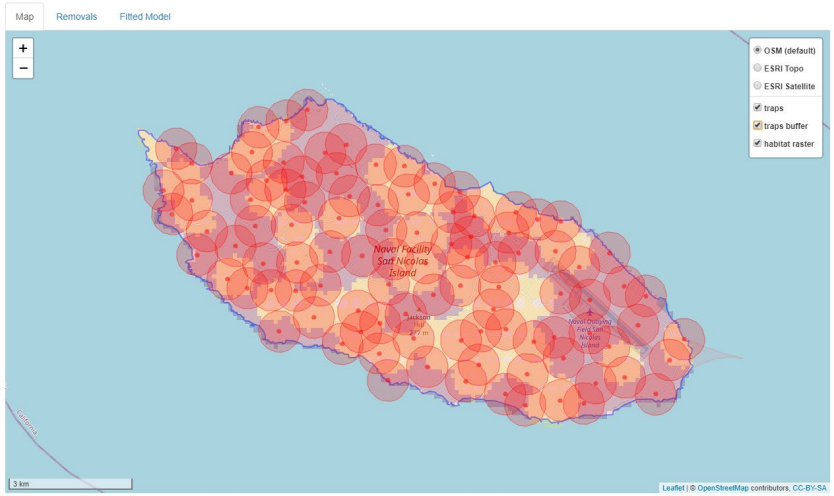
Eradication Phase

- Objectives – track progress towards nominal eradication
  - Collection of monitoring data
    - Deploy selected pest removal strategy
    - Collect data at periodic intervals
    - Collate data
    - Update progress ⟹ Eradication tools
      - Residual population size estimate
      - Residual spatial distribution





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Evaluation phase

- 'Proof of freedom'
- Following completion of eradication phase
- Declaration of nominal pest 'freedom'
  - Assessment of the amount of additional surveillance required to declare eradication success
  - Stopping rules
    - Minimise Type I error (probability of an incorrect declaration)
    - Minimise costs of Type I and II errors (tradeoff surveillance costs with costs of making an incorrect declaration)

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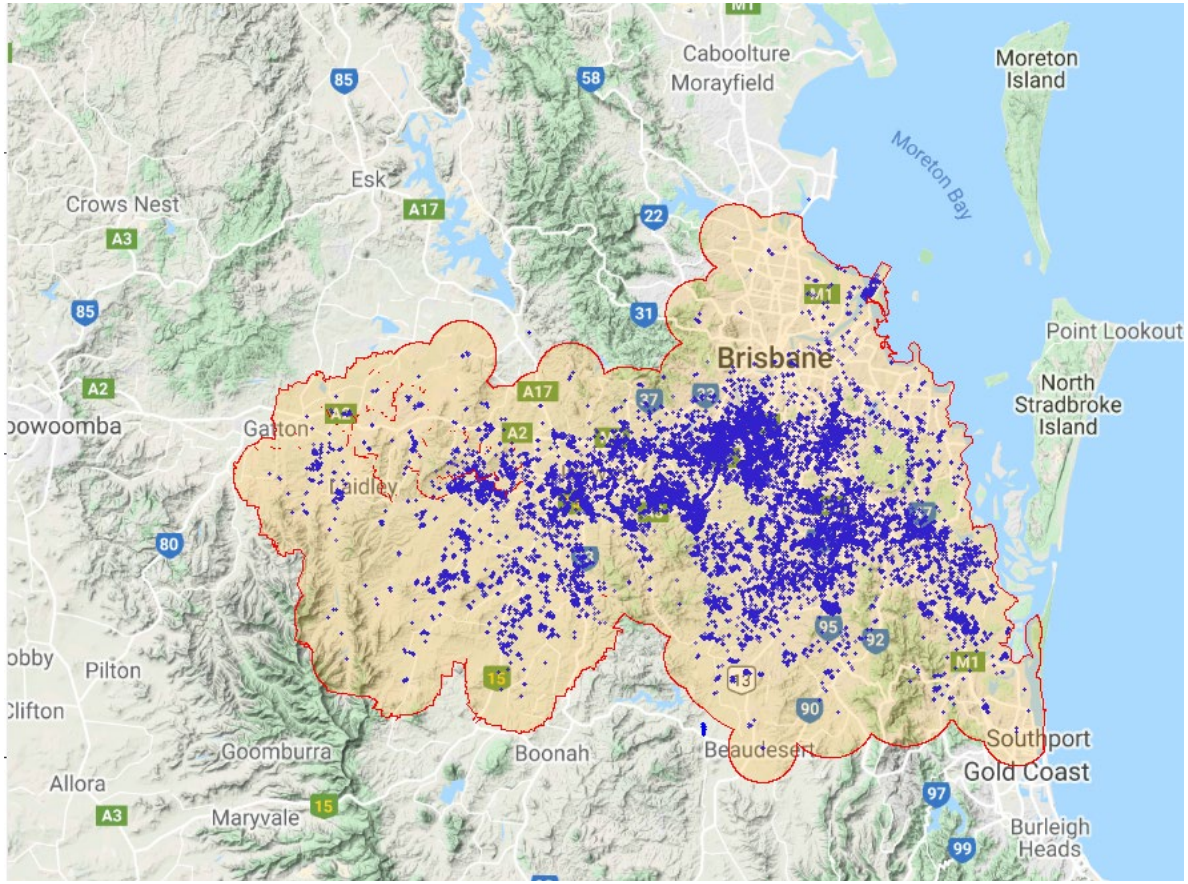
Case Study: Red Imported Fire Ants

- Spatial surveillance model adopted to guide the RIFA eradication program

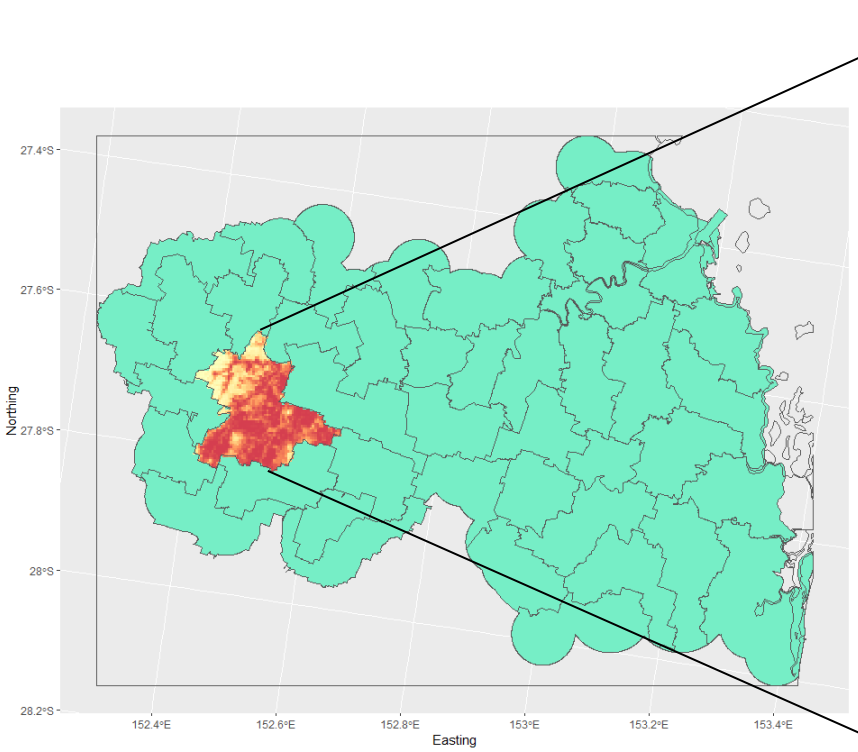


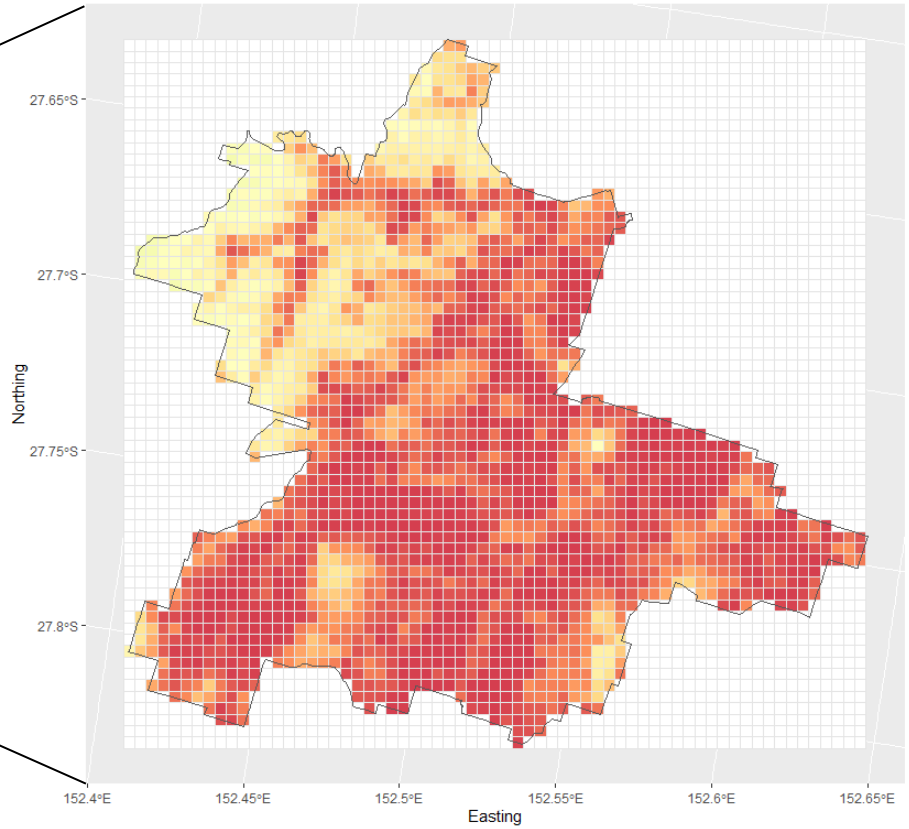
Spatial surveillance

Surveillance Units (360 x 360 m)

Habitat suitability

Management Units





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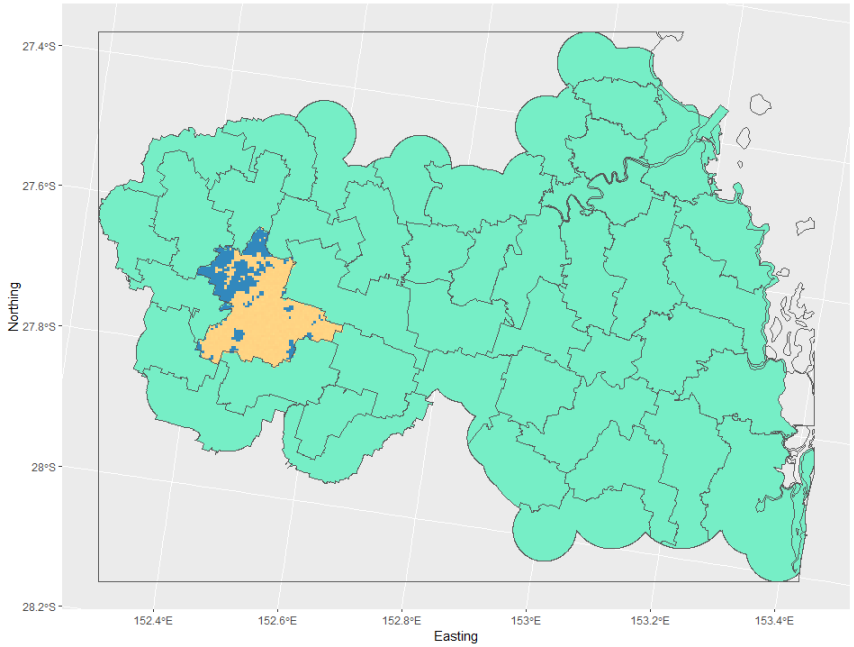
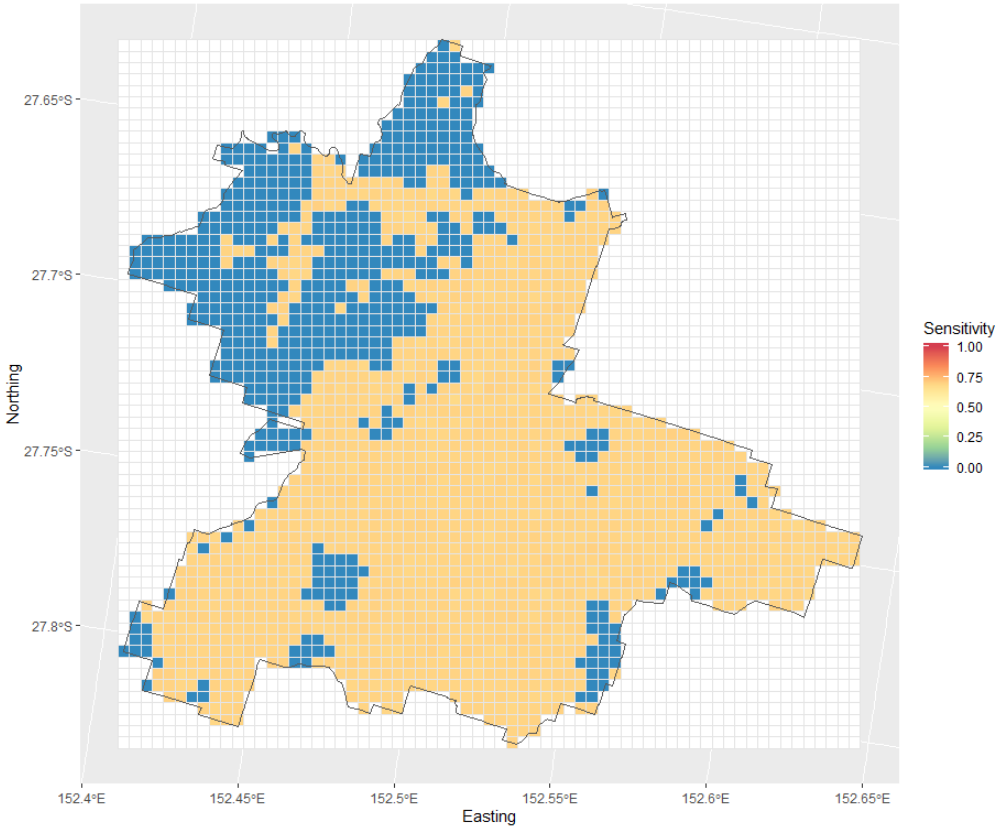
Surveillance sensitivity - SSe

- Assess surveillance sensitivity (SSe) allowing for incomplete coverage



18,000 ha: SSe = 0.55



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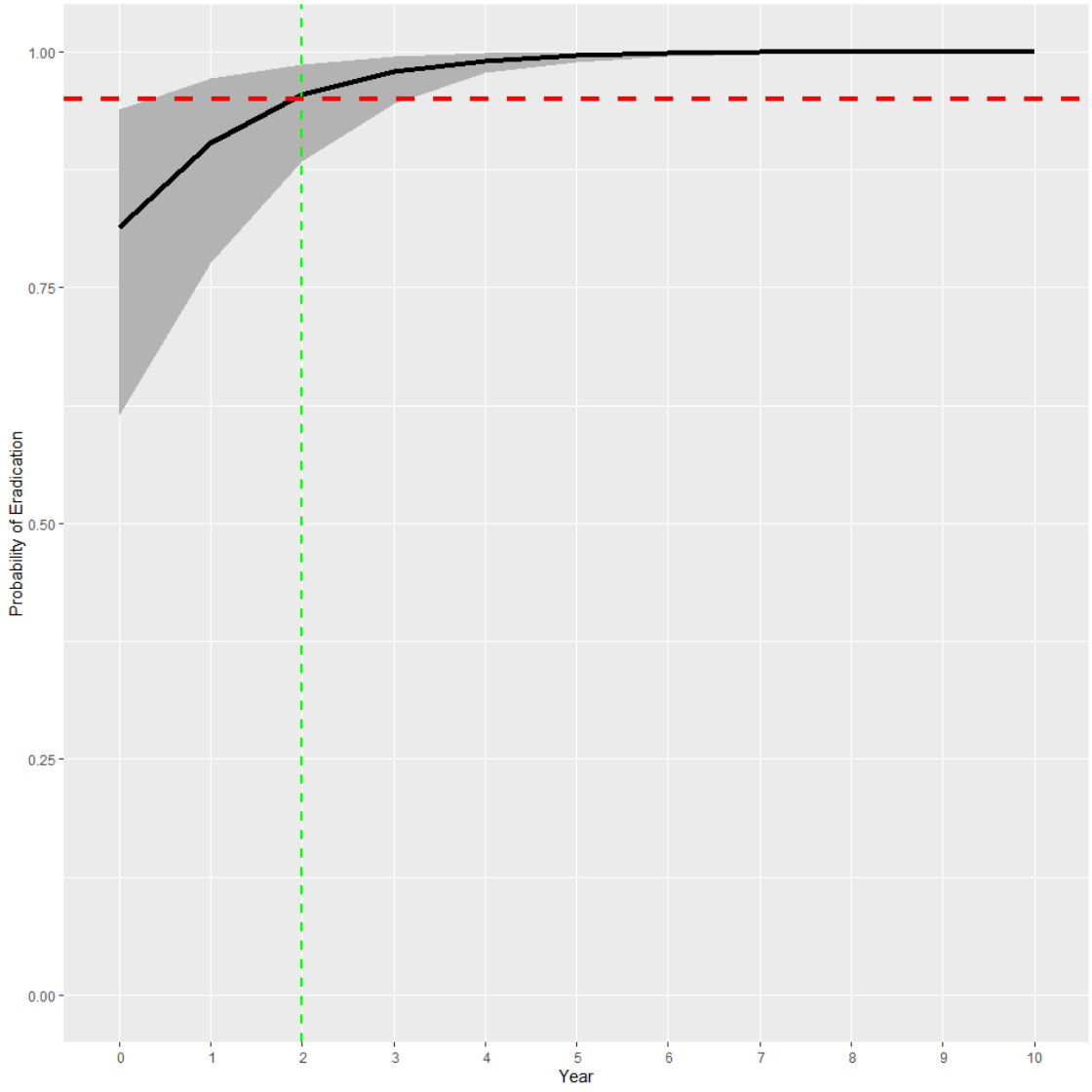
Stage 1: Declaration of freedom in MU

Prior estimate = 0.8 (0.61, 0.92)

Freedom declaration after two years of surveillance (Type I error = 0.05)



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Proof-of-absence module

POA tool example – Stoat eradication in Greater Wellington

Run model | Advanced inputs | Troubleshooting

Shiny proof-of-absence interface

Select example set

CK stoats

Minimum relative risk value

1

epsg

2193

Show 10 entries Search:

	Mean g0	Stdev g0	Mean sigma	Stdev sigma
A24	0.1	0.01	90	10
DOC200	0.1	0.01	90	10
DOC250	0.1	0.01	90	10
VICTOR	0.1	0.01	90	10

Showing 1 to 4 of 4 entries Previous 1 Next

Run params script | Run inputs

Prior min

0.2

Prior mode

0.4

Prior max

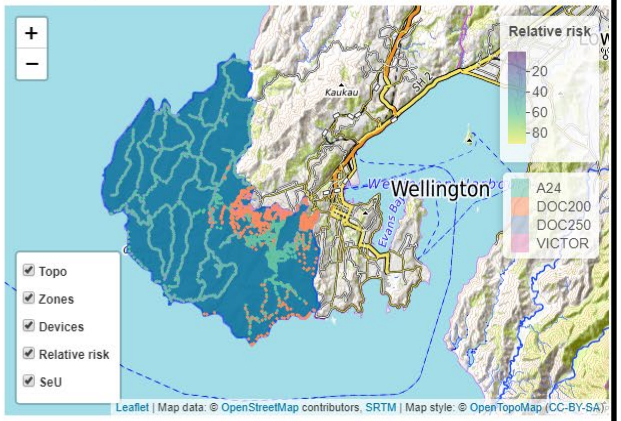
0.85

sigmean

30

Probability of absence

baseMap



Next steps….

- Development of prototype (version 0.1) web-based eradication tools software (October/November)
- Initial road test on active eradication program
  - Coati eradication on Robinson Crusoe Island
- Further road testing/workshops with potential users ??
- Development of eradication 'primer'
  - A handbook about decision support for eradication programs