Combining detection and eradication probabilities to fast track TB freedom in the Hokonui Hills
Biosecurity Bonanza Seminar,
Wellington 25 May 2015
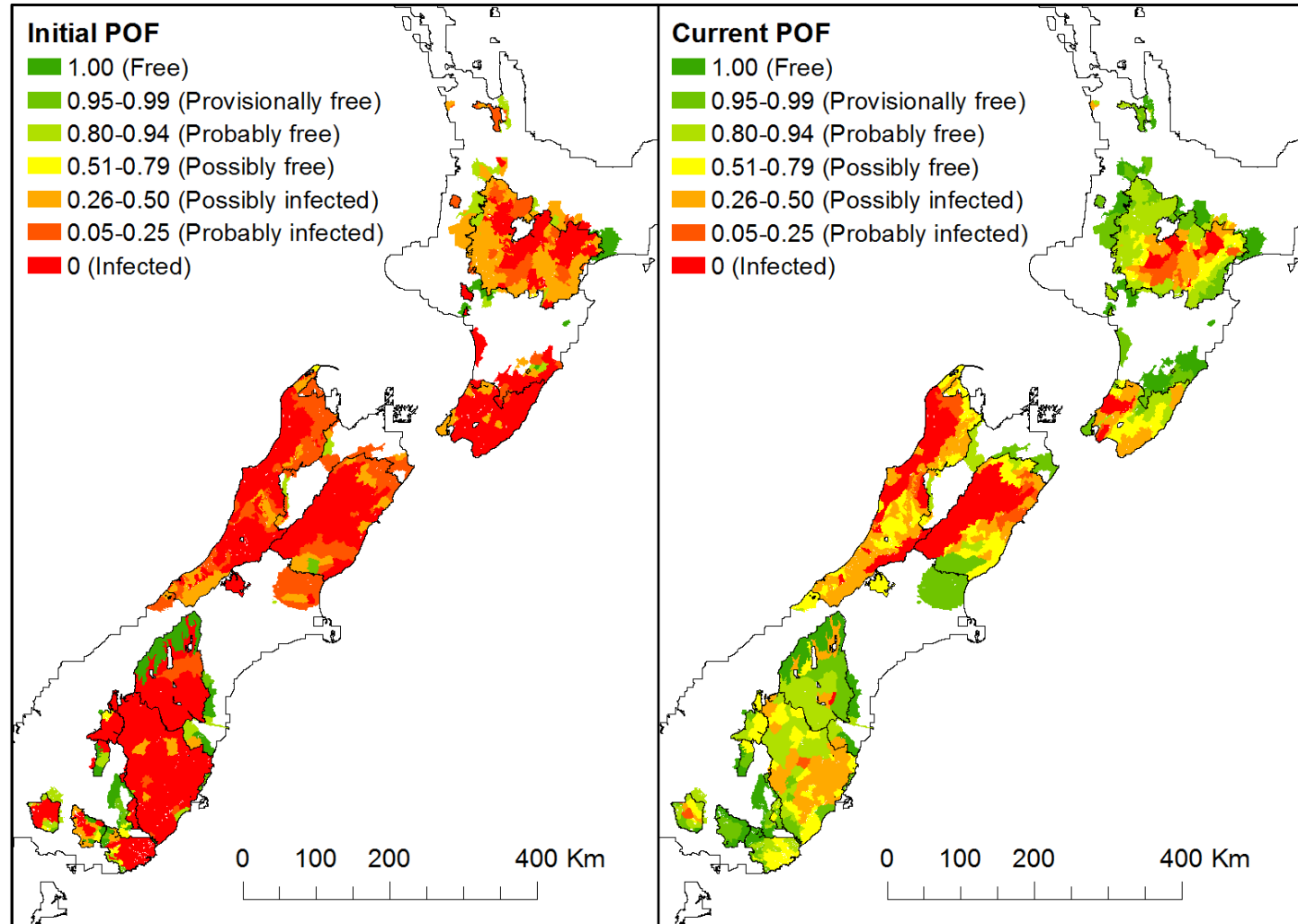
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Progress toward TB Freedom:
Probabilities of TB freedom then and now

Prob of Freedom
(PoF) assigned by
Area Disease
Managers

Initial PoF is for
the year in which
the area was
declared as
Vector Risk Area

Current is for
2015

We are in the TB end game!
Declaring TB freedom and stopping

- Since 2012 1.1m ha has been declared free of TB in wildlife

  - ~10% of 10.5 m ha with TB

  - Vector Risk Area status revoked

  - cessation of active management

- Management emphasis switching from control to TB surveillance (necropsy)

  - to 'prove' Tb absence

=> New(ish) imperative for more cost effective surveillance strategies and techniques

Declaring TB freedom: Current approach

- Possum **control** for >10 years

- Direct or indirect **surveillance** to try and find TB in wildlife

- Calculate probability of TB Freedom (PoF) based on modelling of control history and surveillance

- Stop when PoF > 0.95

Control then Surveillance paradigm (CtS)
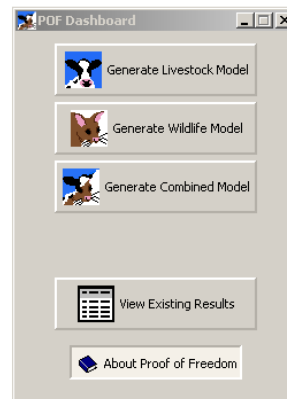
Declaring TB freedom: New approach

- Possum **control** for < 5 years

- Begin **surveillance early** to try and find TB in wildlife

  - If TB found, apply control for another 5 years

  - If no TB found, apply high intensity control likely to eliminate all of very few TB possums (if any) present

- Calculate probability of TB Freedom (PoF) by combining survey data with control efficacy data
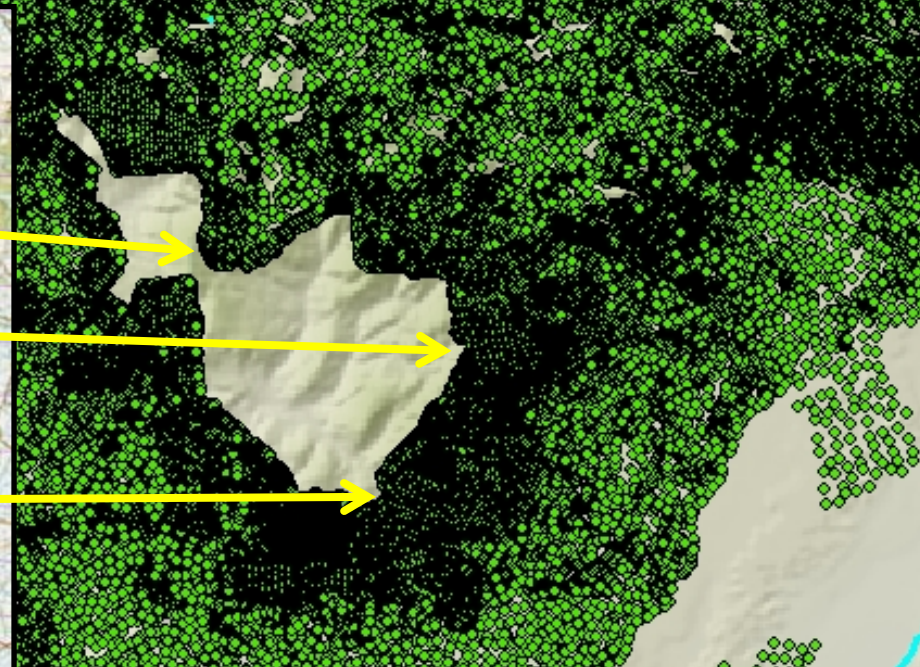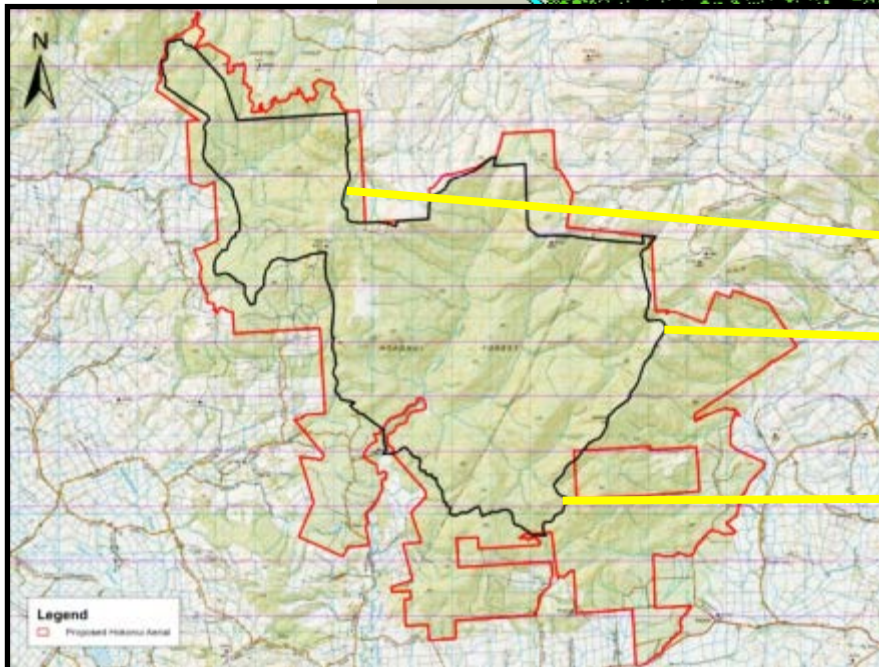
=> 'Survey then Control' (StC)

First test of StC feasibility
Hokonui Hills VCZ

- 6500 ha central bush area
- Not intensively surveyed since 2006
- Huge survey effort in surrounding bush areas

Legend

☐ Hokonui VRA

● HokinuiVectorNetSurveyPoints

New Zealand

Approach to possum survey and control

- March 2104 (Possum trapping):
  - Measure RTCI, radio tag/release 99 possums for %kill estimation
  - Palpate possums for TB
- April 2014: Main trapping & necropsy survey
  - Measure TB prevalence (expecting zero)
- May 2014: Aerial control
  - Dual prefeed cereal 1080 baiting
- June 2014: Carcass search & radio-tracking
  - Mark- Recapture density estimate
  - Determine % radio collars killed
- August 2014: Repeat RTCI
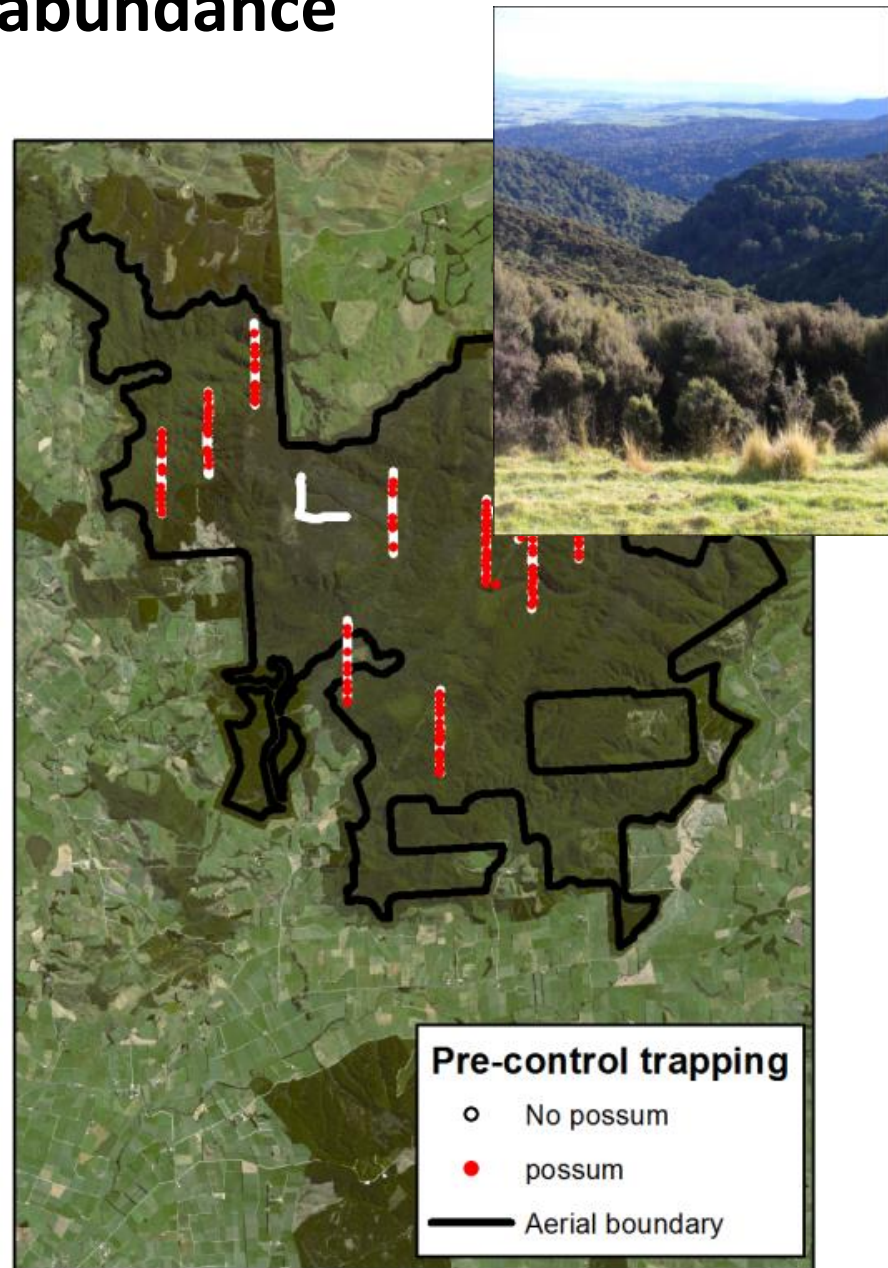 - Complementary measure of %kill

Possum relative abundance

- Trap Catch Index (TCI) = 6.7%

- Possum density*

    = 1.3 ha^{-1}

$\Rightarrow$ Applying standard calibration implies population of 8700 possums in Hokonui Hills VCZ

Pre-control trapping
- ○ No possum
- ● possum
- — Aerial boundary

assuming 5:1 TCI:density ratio

Possum TB prevalence: No TB found

- Sample size = 539 possums
    - 241 palpated in initial trapping
    - 271 necropsied from main survey
    - 27 possums found dead during carcass searches

- Effective sample size = 426
    - After allowing for less than perfect detection of TB during necropsy

⇒ Nominally only 5% of population surveyed for TB

⇒ **Only 5% chance TB would have been detected***

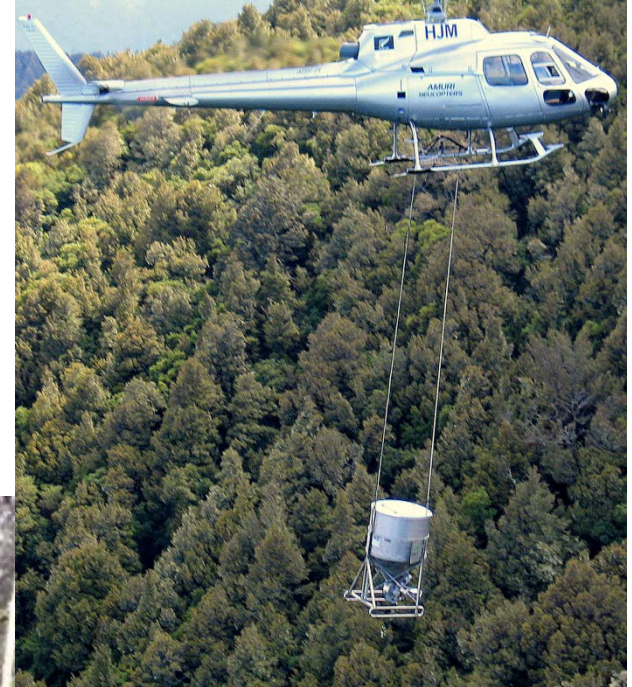*if* only a single TB possum was present
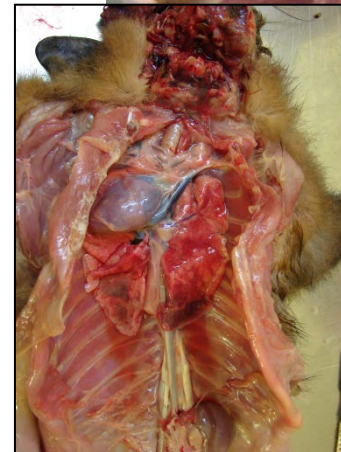
Aerial 1080 operation: Control effectiveness

- Bait sown 31 May
- 89 radio-collared possums still present in baited area
- 85 killed (all before night 2)

$\Rightarrow$ **95.5% kill**

- Post-control RTCI = 0.27%
  - 4 possums – but 3 at boundary
    - excluding them RTCI =0.07%

$\Rightarrow$ **96.9-99.0% kill**

Density estimation: carcass searches

- Searched 374 ha near traplines – unaided by radios
    - 33 possums found, 7 radio tagged
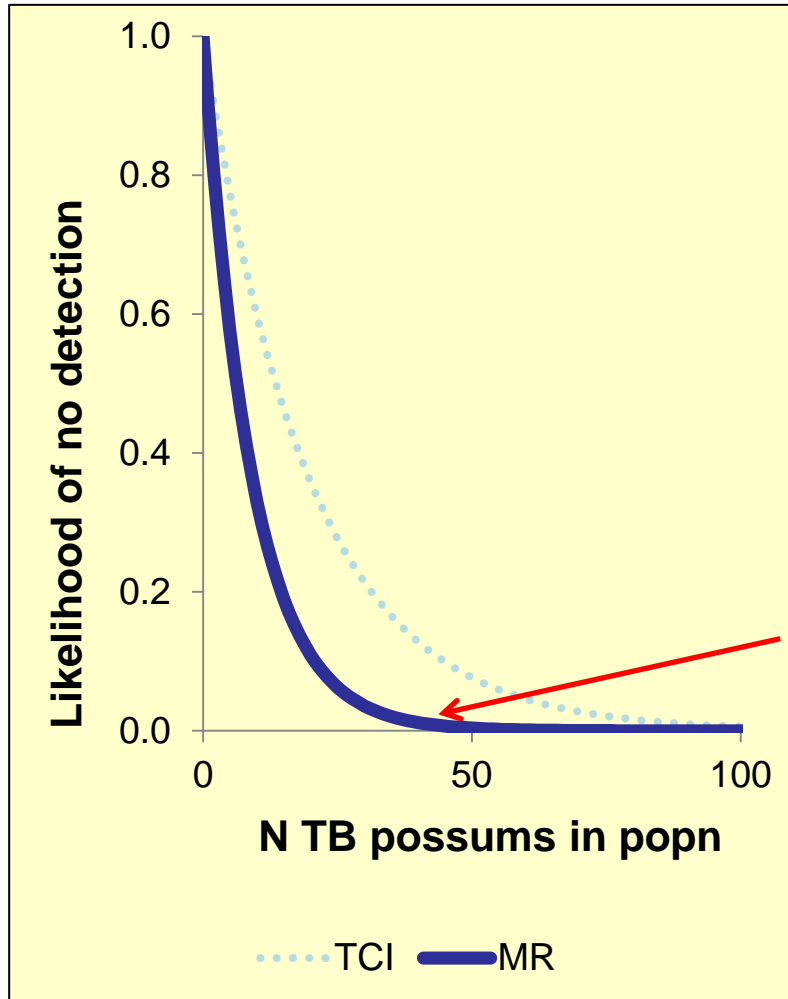- Another 49 collared possums <u>then</u> found with radio tracking

⇒ Mark-Recapture estimate of actual possum density = 0.63/ha

⇒ Total pre-control popn = 4050

⇒ **~11% of popn surveyed for TB**

Estimating the probability of TB freedom - Step 1:
What chance we could have detected TB?

Likelihood of no detection (y-axis: 0.0 to 1.0)

N TB possums in popn (x-axis: 0 to 100)

····· TCI ━━ MR

Surveillance

- Calculate probability of no TB detection (the observed result)

if

- 1,2, 3, 4, …or more TB possums actually present

⇒ certain to have detected TB if >40 Tb possums were still present

⇒ **i.e.; there were less than 40 TB possums in the Hokonui Hills***

If randomly distributed

Estimating the probability of TB freedom - Step 2:
What chance <u>all</u> TB possums killed?

- Calculate probability all of TB possums killed by the 95.5% kill

<u>if</u>

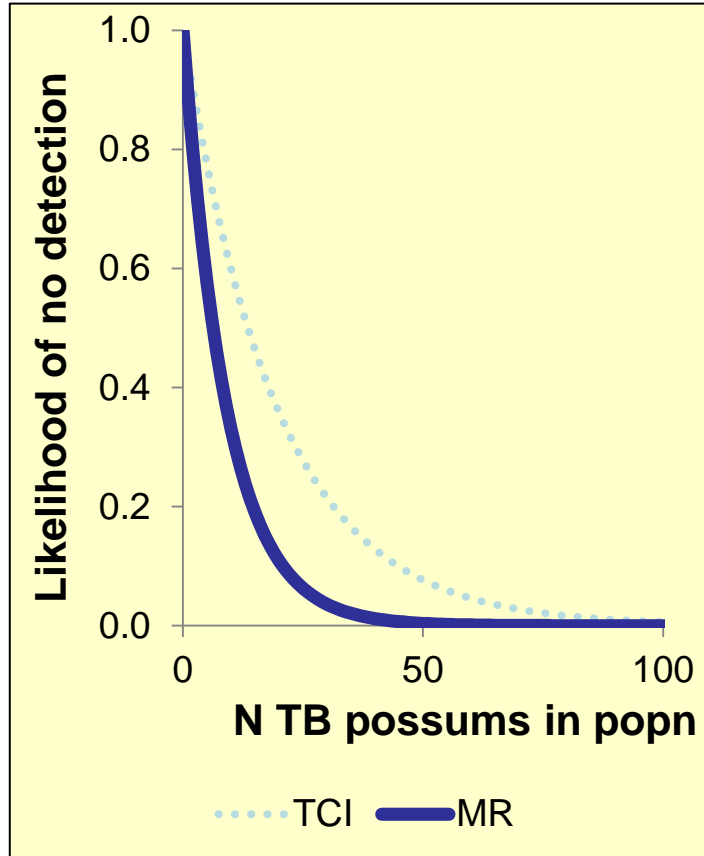- 1,2, 3, 4, …or more TB possums actually present

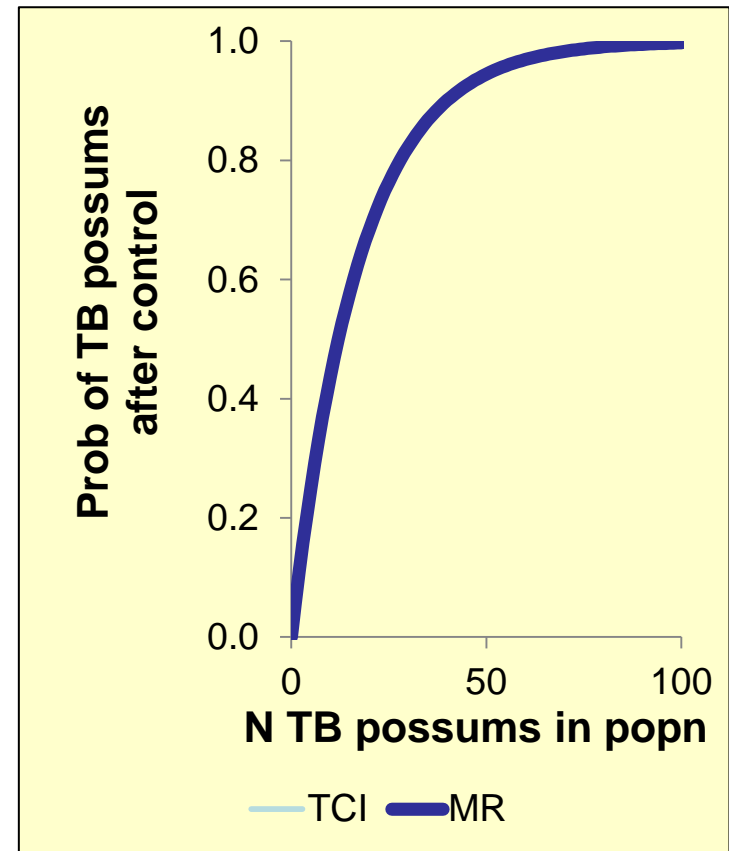⇒ At least one TB possum certain to have survived if more than 50 Tb possums were still present
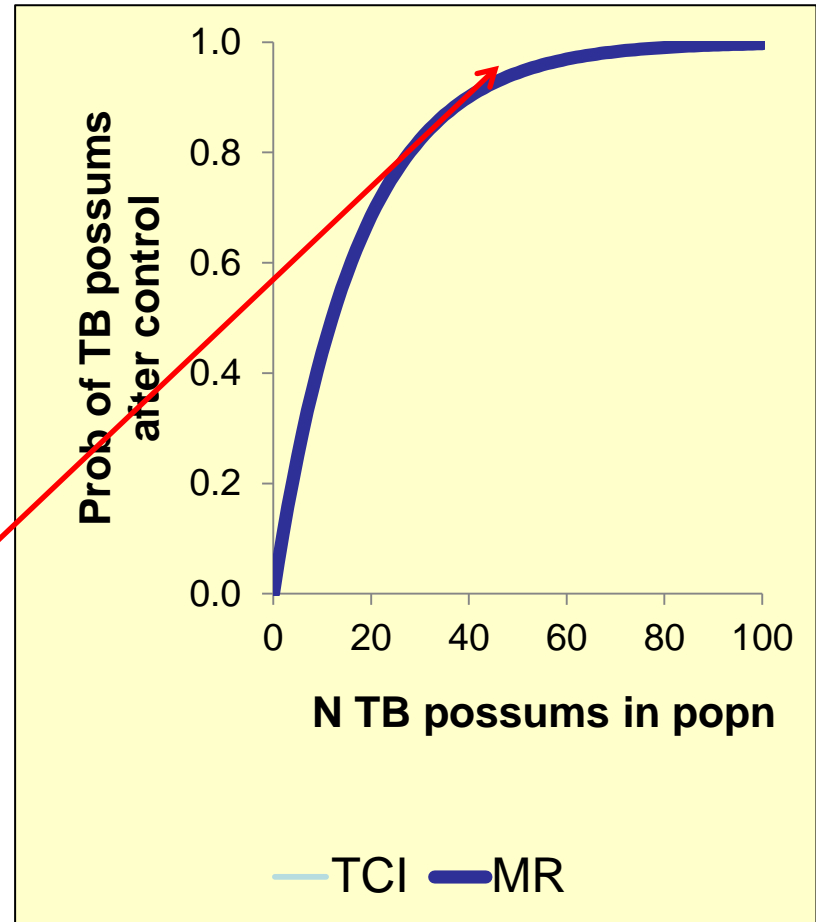
Control

Estimating the probability of TB freedom - Step 3:
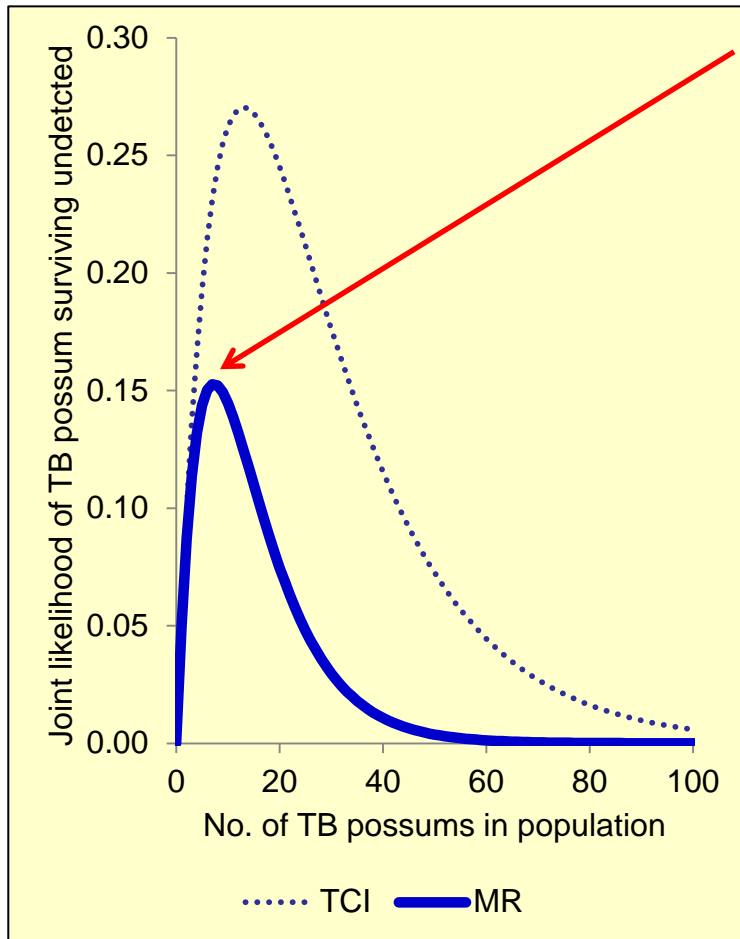## What joint chance a TB possum would both survive and be undetected?

Estimating the probability of TB freedom - Step 3 (cont):
Combine detection and survival probabilities

- At worst , only 15% chance that any TB possum would survived undetected

⇒ 85% probability of TB freedom even though only 10% of the population surveyed

⇒ 99% confident that no more than three TB possums could have survived the operation

Estimating the probability of TB freedom - Step 4:
Taking prior belief into account

- TB modelling indicates high prob of Tb freedom even before control (prior PoF>0.90)

⇒ **Post-control POF >0.98**

- **AND** residual density (0.04-0.07 possums/ha) too low for TB persist and recover if ≤ 3 present

⇒ **POF >0.99**

Prob suriving undetcted

N TB possums in popn

.... TCI ▬▬ MR
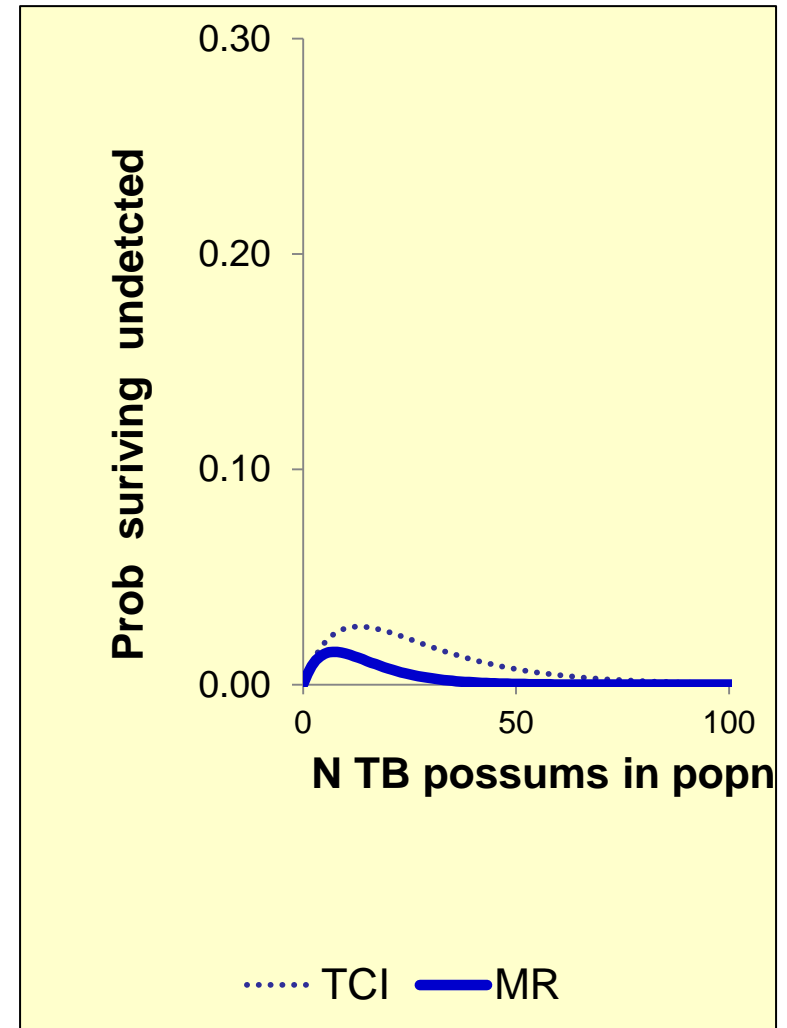
Summary

- StC approach indicates that TB is already gone from possums in Hokonui Hills VCZ

    - or, worst case, will disappear soon

    - especially since estimates are conservative

- Some key caveats:

    1. Random possum distribution assumed

        - But will be clustered -compensated for by assuming 1/N design prevalence

    2. TB may still be in long lived deer

        - but possum density too low for Tb to re-establish]

$\Rightarrow$ **Hokonui Hills could be declared free now**
(esp with 3- 5 more yrs of pig/deer assurance surveys)