Knowing When to Walk Away Doesn’t Have to be a Gamble:

Optimisation of the Stopping Threshold for Surveillance of TB in Wildlife.

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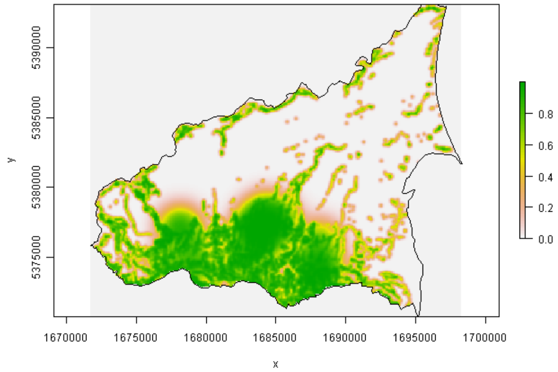
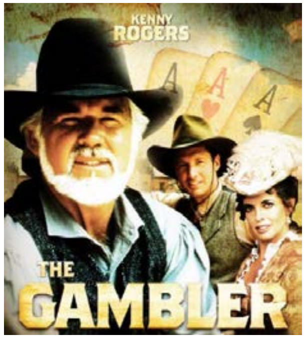
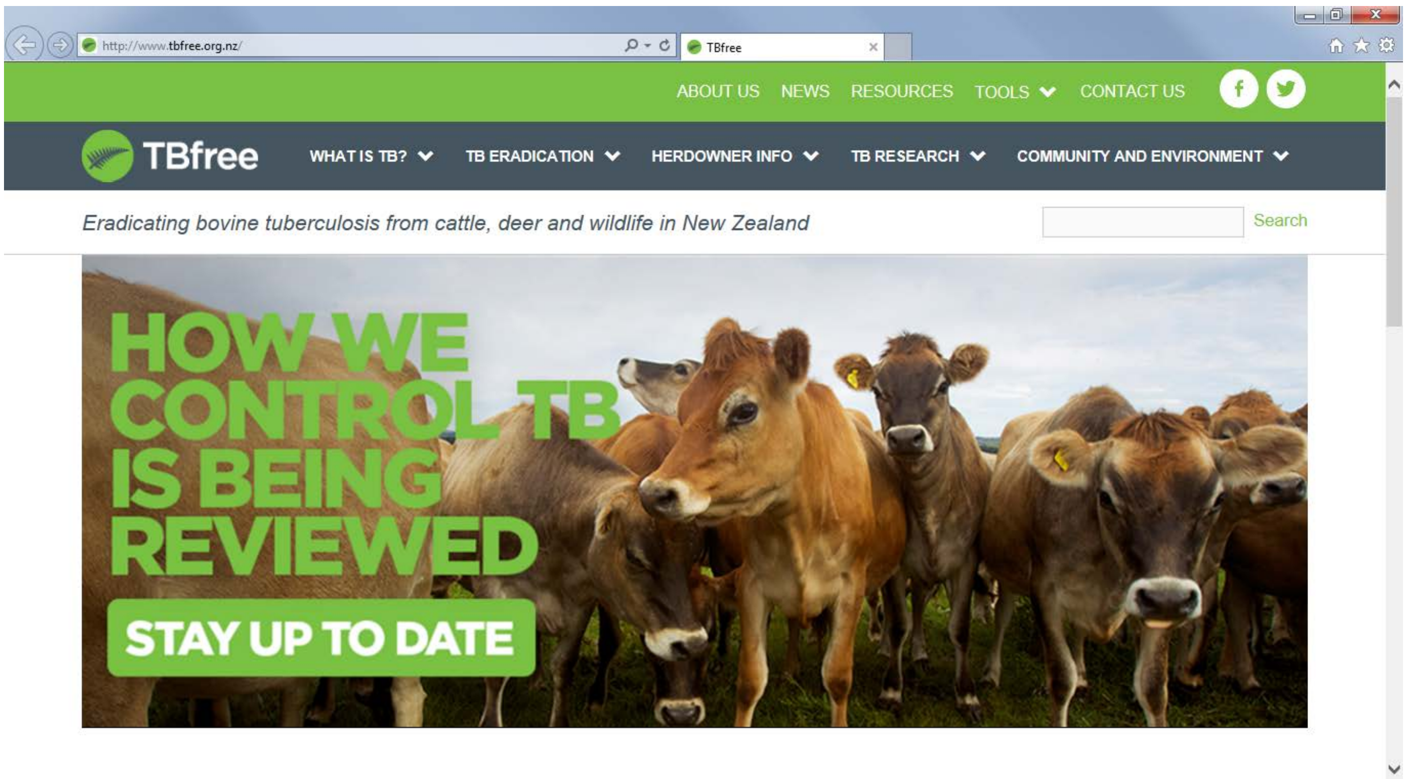


LANDCARE RESEARCH
MANAAKI WHENUA



Background

OSPRI's **TBfree** programme aims to eradicate bovine TB from New Zealand



Background

Control to *Achieve* TB Freedom

- Livestock Testing

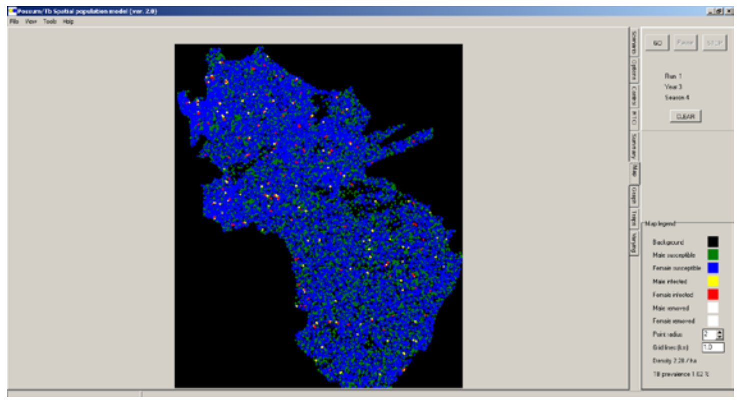
- Wildlife Vector Control (possums)

Surveillance to *Prove* TB Freedom

How do we know when we've done enough?

Proof of Freedom (PoF) Methodology

1. **Prior** probability from control history



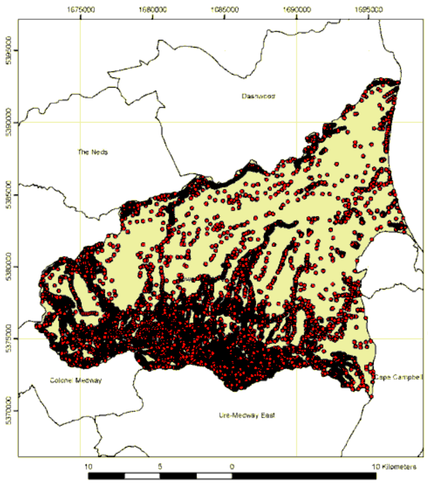
Prior

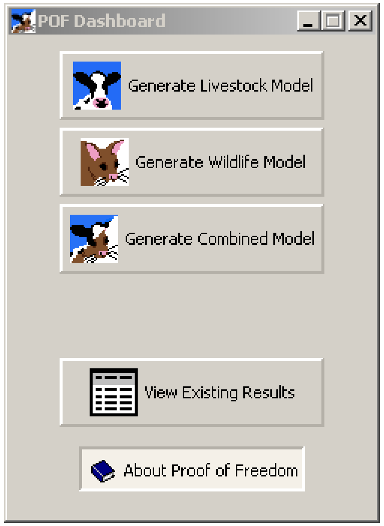
Years since TB
TB in surrounding areas

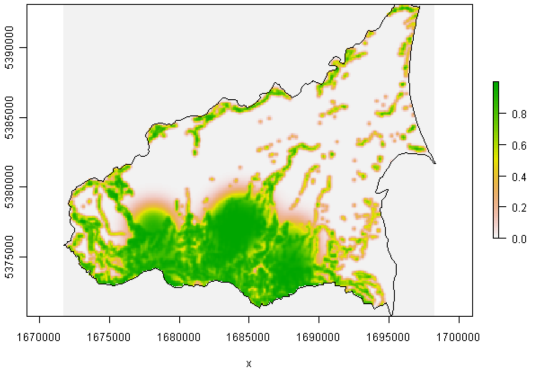
What is the chance no TB possums remain after control?

Proof of Freedom (PoF) Methodology

1. Prior probability from control history
2. **Sensitivity** from surveillance



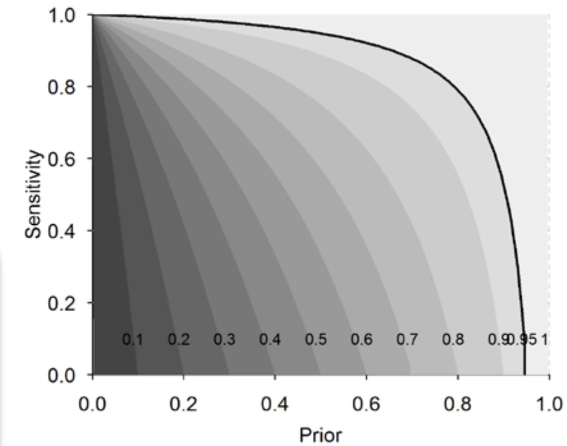




If TB possums are present, what is the chance we would find them?

Proof of Freedom (PoF) Methodology

1. Prior probability from control history
2. Sensitivity from surveillance
3. Combine *Prior* and *Sensitivity* to obtain ***PFree***

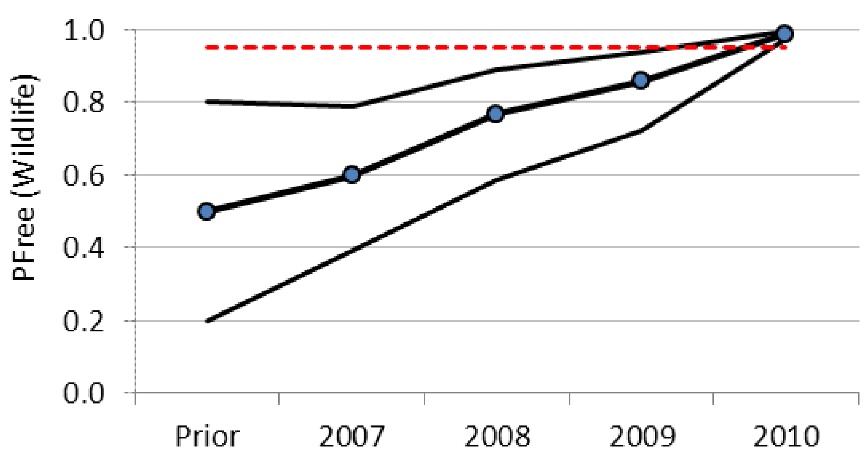


What is the probability the area is free of TB given no TB possums were found?

$$PFree = \frac{Prior}{1 - (Sensitivity(1 - Prior))}$$

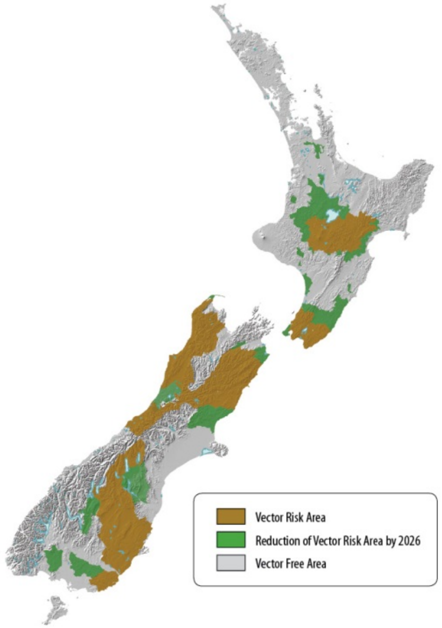
Proof of Freedom (PoF) Methodology

1. Prior probability from control history
2. Sensitivity from surveillance
3. Combine *Prior* and *Sensitivity* to obtain *PFree*
4. Repeat surveillance until PFree ≥ 0.95



Outcomes from declaring freedom

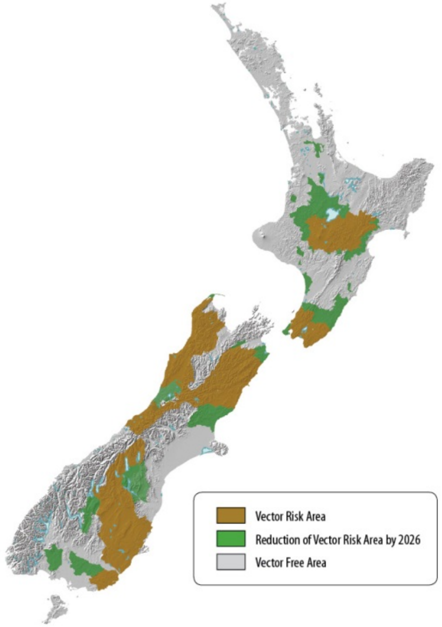
- Correct decision made
  - No TB, therefore **no consequences**
    - (95% of time)



- Incorrectly declare freedom
  - TB remains therefore will have to **re-control**
    - (5% of time)

What Happens in Practice

- OSPRI assess risk **subjectively** for each VCZ and adjusts the PoF stopping threshold
    - Cost of re-control, existing surveillance (e.g. herds).
    - Best knowledge of OSPRI staff.



Project Aim

Landcare Research
Manaaki Whenua

How can we set the stopping threshold for each VCZ in a more objective manner?

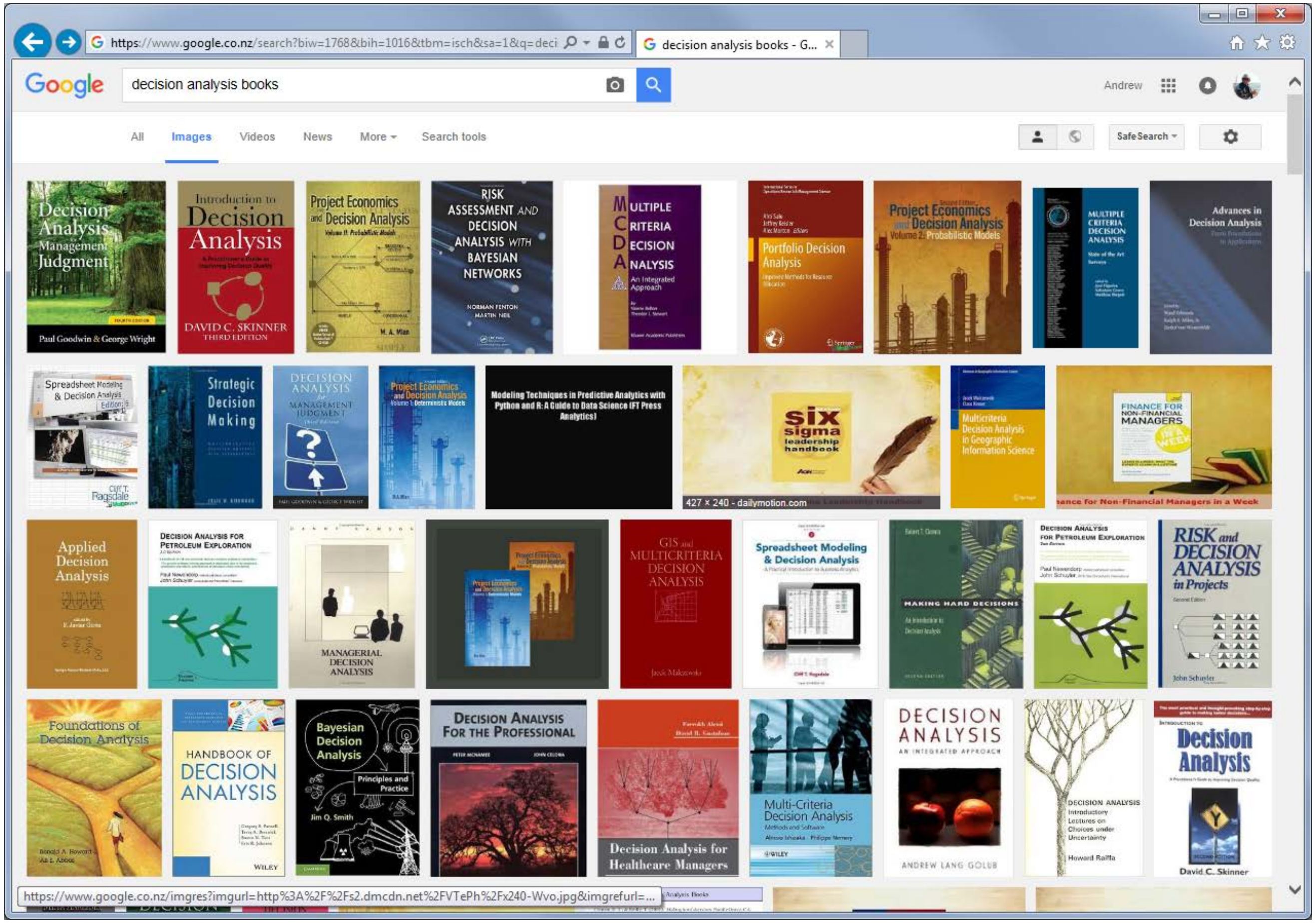
OSPRI Research Aims

OSPRI

"Continuous refinement of methods to ensure efficient and effective programme delivery"

Decision Theory

- Making choices under uncertainty



Decision Theory

- Making choices under uncertainty
- Weigh up the **cost** and the **chance** of being wrong for each alternative
  - "Expected Cost"

Expected Costs

Actual cost × Chance of incurring that cost

Should I get House Insurance?

- Yes – buy a policy :

  = \$400 × 100%

  = **\$400**

- No – hope house doesn't burn down:

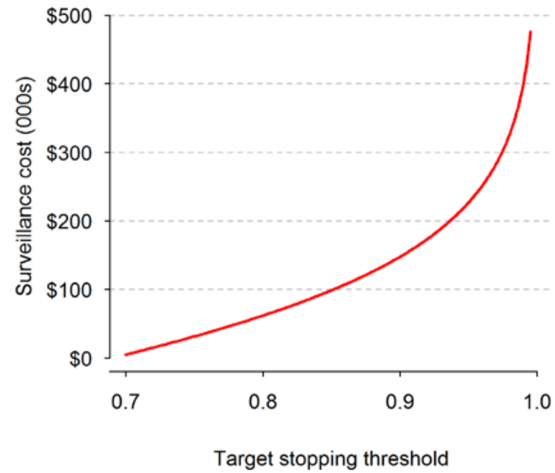
  = (\$0 × 99.9%) + (\$500,000 × 0.1%)

  = **\$500**

Wildlife TB: Costs

1. Surveillance costs

- Cost of surveillance for any stopping value.



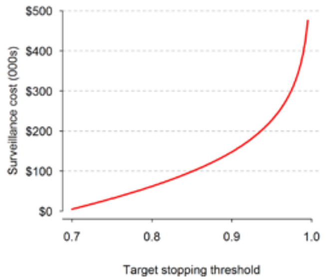
2. Re-control costs

- Cost of returning and doing more control and surveillance
  - Also socio-political costs

Wildlife TB: Chance of Incurring Costs

1. Surveillance costs

- 100% chance

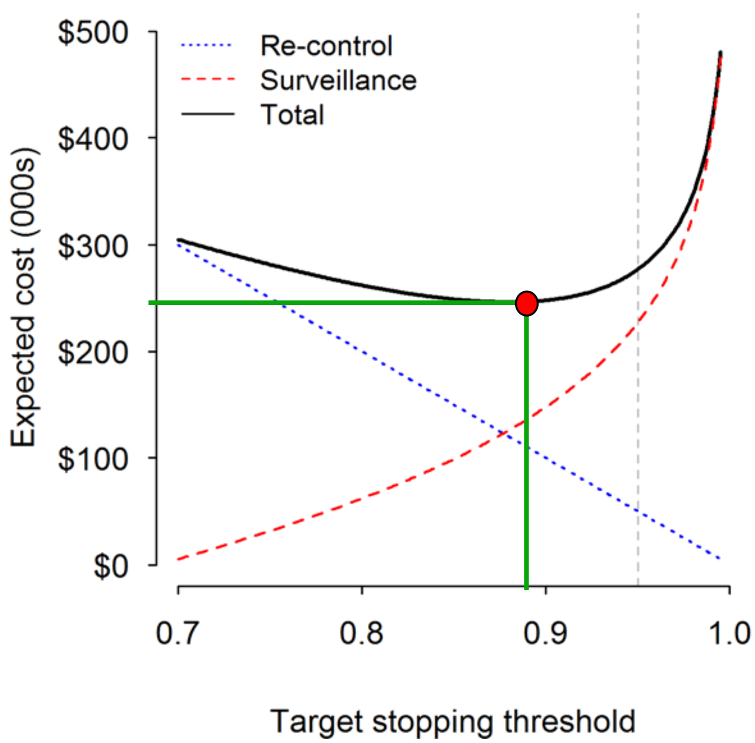


2. Re-control costs

- 1 – stopping value

Total Expected Cost

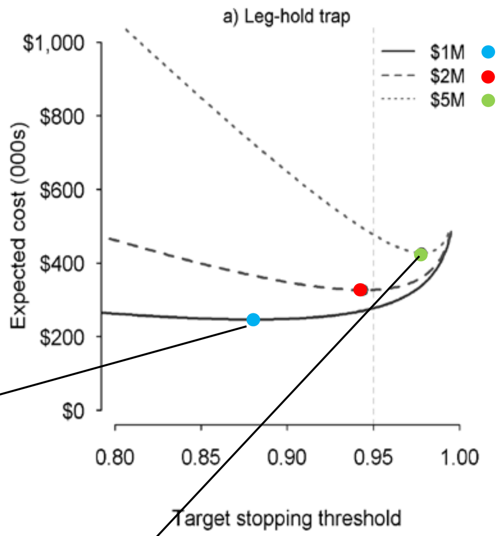
TEC = *Expected cost of surveillance + Expected cost of Re-control*



Optimal stopping level is where TEC is minimised (0.89)

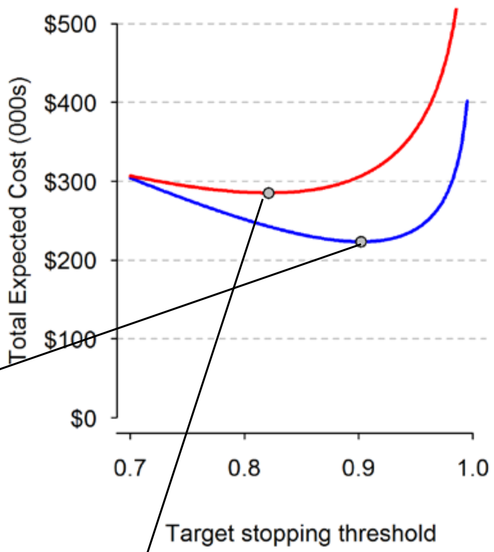
Optimal Value Depends on Many Factors

- If **re-control** costs are **higher**, the optimal threshold is **higher**
  - Hedge against expensive re-control



Optimal Value Depends on Many Factors

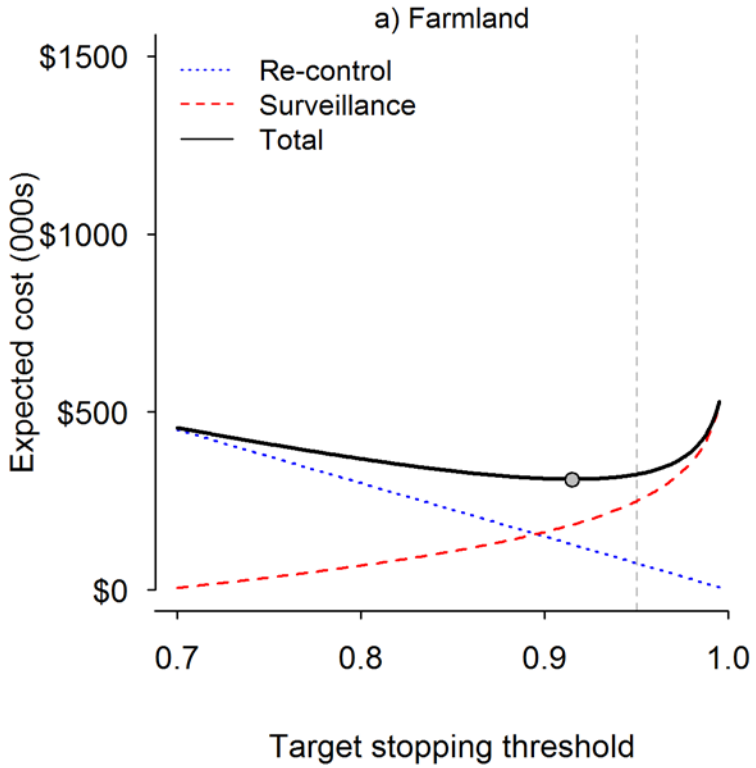
- If **surveillance** costs are **higher**, the optimal threshold is **lower**
  - Reduce costly surveillance

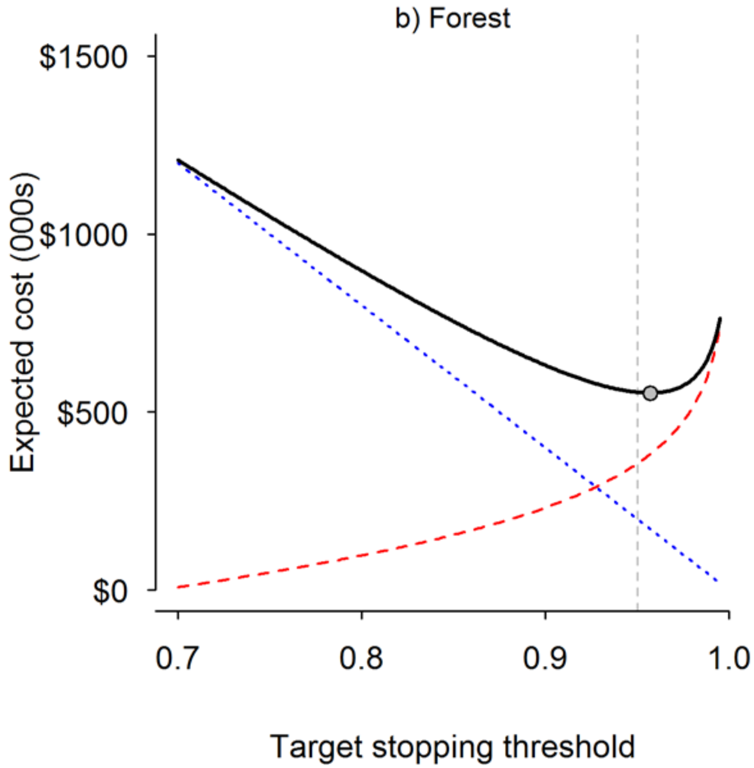


Getting the Balance Right

- Farmland VCZs:
  - Low cost of re-control (stop sooner)
  - Low cost of surveillance (stop later)
- Forest VCZs:
  - High cost of re-control (stop later)
  - High cost of surveillance (stop sooner)

Getting the Balance Right





Problem with Expected Cost

House insurance example revisited:

House value is $500K. Chance of losing it = 0.01% Policy costs $500

a) Pay **$500** per annum

E($) = $500

b) Pay **$0**, but risk losing **$500K**

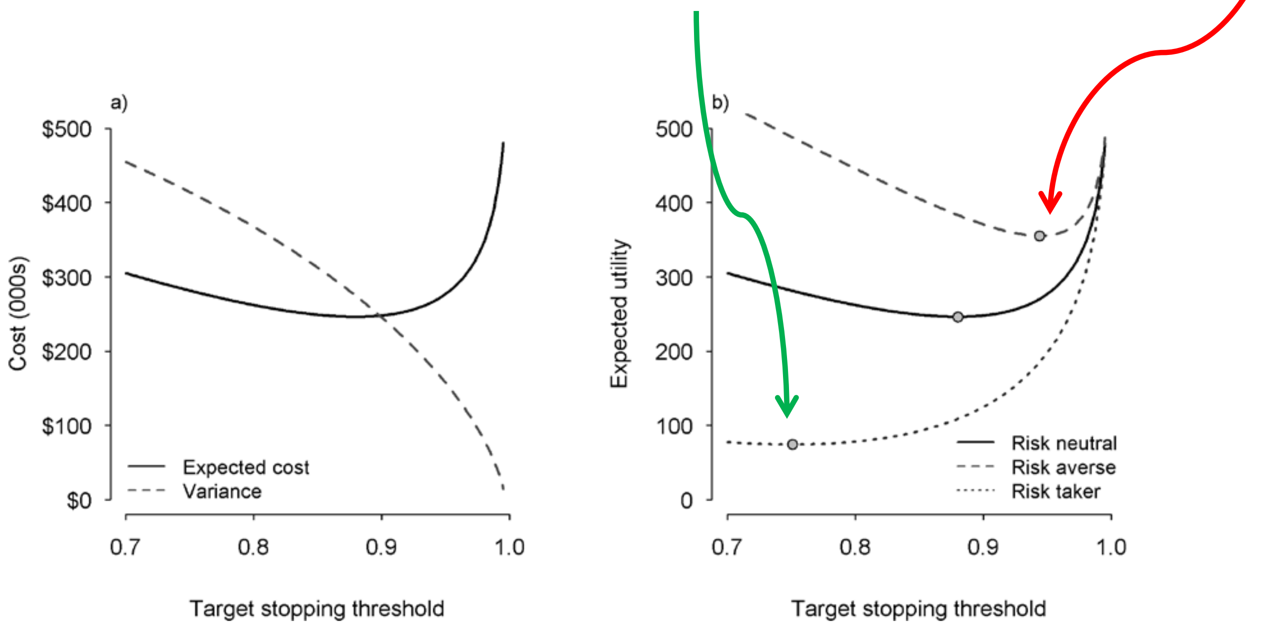
E($) = $50

Your choice will depend partly on whether you are **risk-averse** or a **risk taker.**

Including "Risk Appetite"

- Use **Expected Utility** (includes variance of actual costs)
- Can include socio-political costs & qualitative info.

  - Risk averse – choose higher stopping threshold
  - Risk taker – choose lower stopping threshold



Summary: Decision Analysis Approach

1. Robust framework for OSPRI staff to tailor the stopping value for each VCZ
2. Level is **different** for each VCZ due to differences in costs and other factors
3. Provides quantitative rigor to support/replace subjective approach.

Acknowledgments

- This project was funded by OSPRI who manage the TBfree programme

OSPRI

TBfree