

Optimal Surveillance Measures to Protect Environmental Assets

Tom Kompas

Australian Centre for Biosecurity and
Environmental Economics

Crawford School of Economics and Government
Australian National University

www.acbee.anu.edu.au



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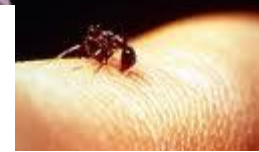
The Problem

Close proximity between countries and international trade and tourism increases the probability of an incursion and the spread of exotic diseases and pests; ones that can do great harm, and in some cases can be potentially devastating to local industry, animal and human health, and the environment.





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Traditional Measures

- Pre-border measures and border quarantine (i.e., preventing a potential incursion at the border).
 - Limits on imports
 - Airport inspections, and inspections of shipping containers and contents
- Local surveillance programs (preventing spread in the local environment).
 - Screening and local awareness
 - Surveillance traps (e.g., insects)
 - Blood screening and visual inspection
- Containment and eradication programs.

The Economic Puzzle

How much should be spent, or what costs should be incurred, for pre-border measures and border quarantine, surveillance and containment/eradication activities to protect human, plant and animal health as well as the environment? How to allocate resources across various threats?

- Ban imports and close airports?
- Spend \$0 on quarantine and surveillance?
- Spend all of GDP on quarantine and surveillance?
- Eradicate? Contain? Neither?
- How to allocate resources across various threats?
- Who Pays? Cost Sharing?

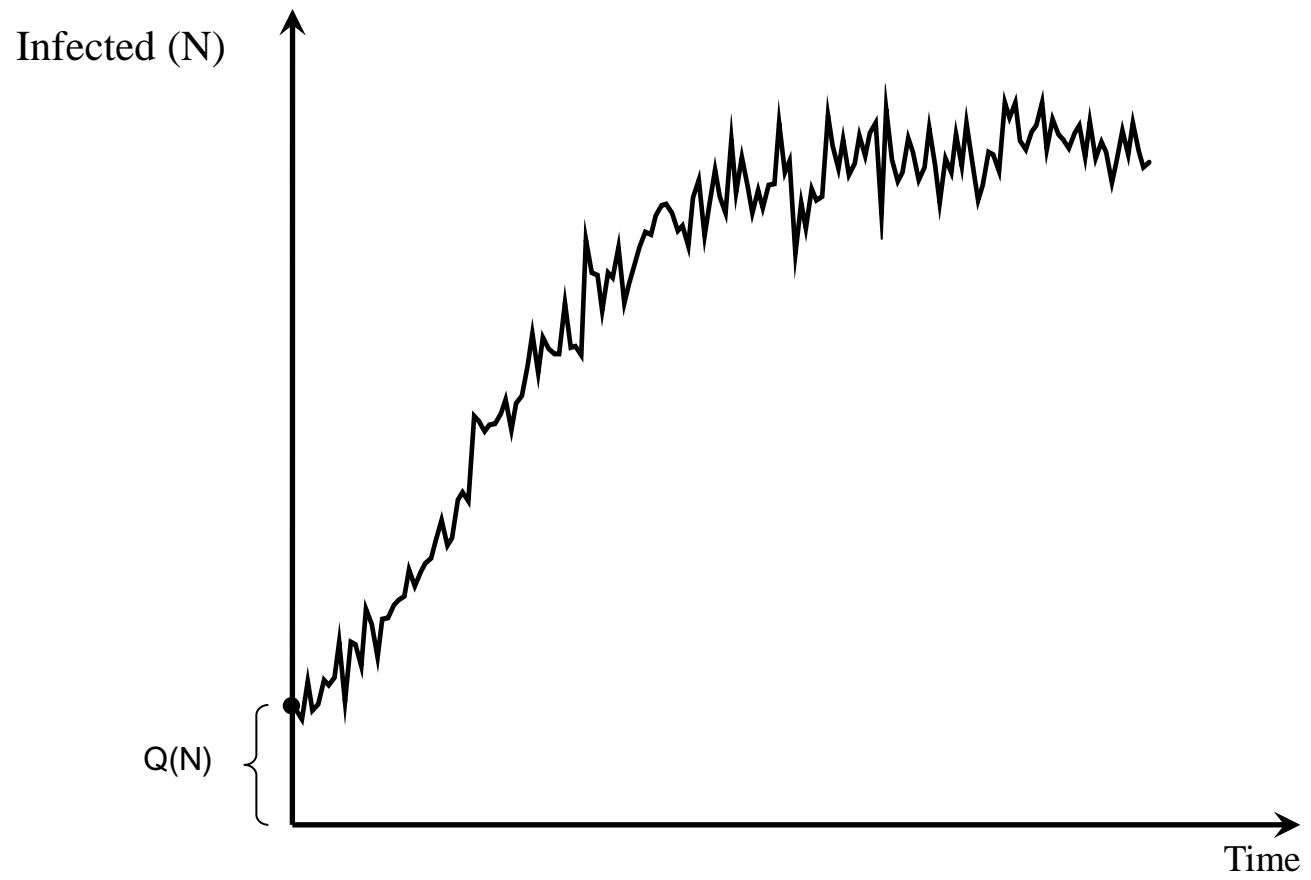


Containment and Eradication



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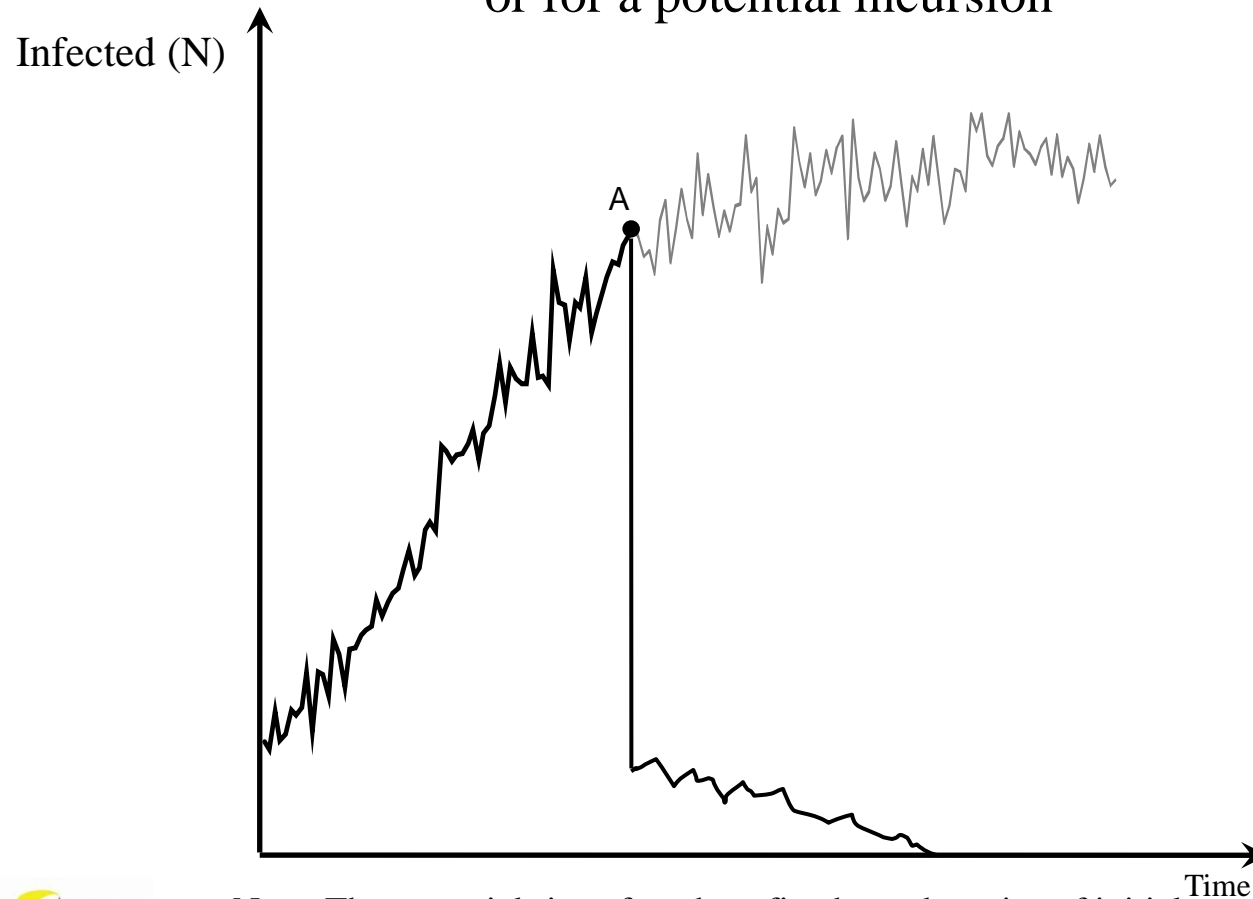
A Simple Spread Model for an Invasive





Containment and Eradication

The role of cost-benefit analysis (CBA) after an incursion,
or for a potential incursion



Note: The potential size of net benefits depend on size of initial entry and chosen eradication/containment exercise, relative to point of detection (A).

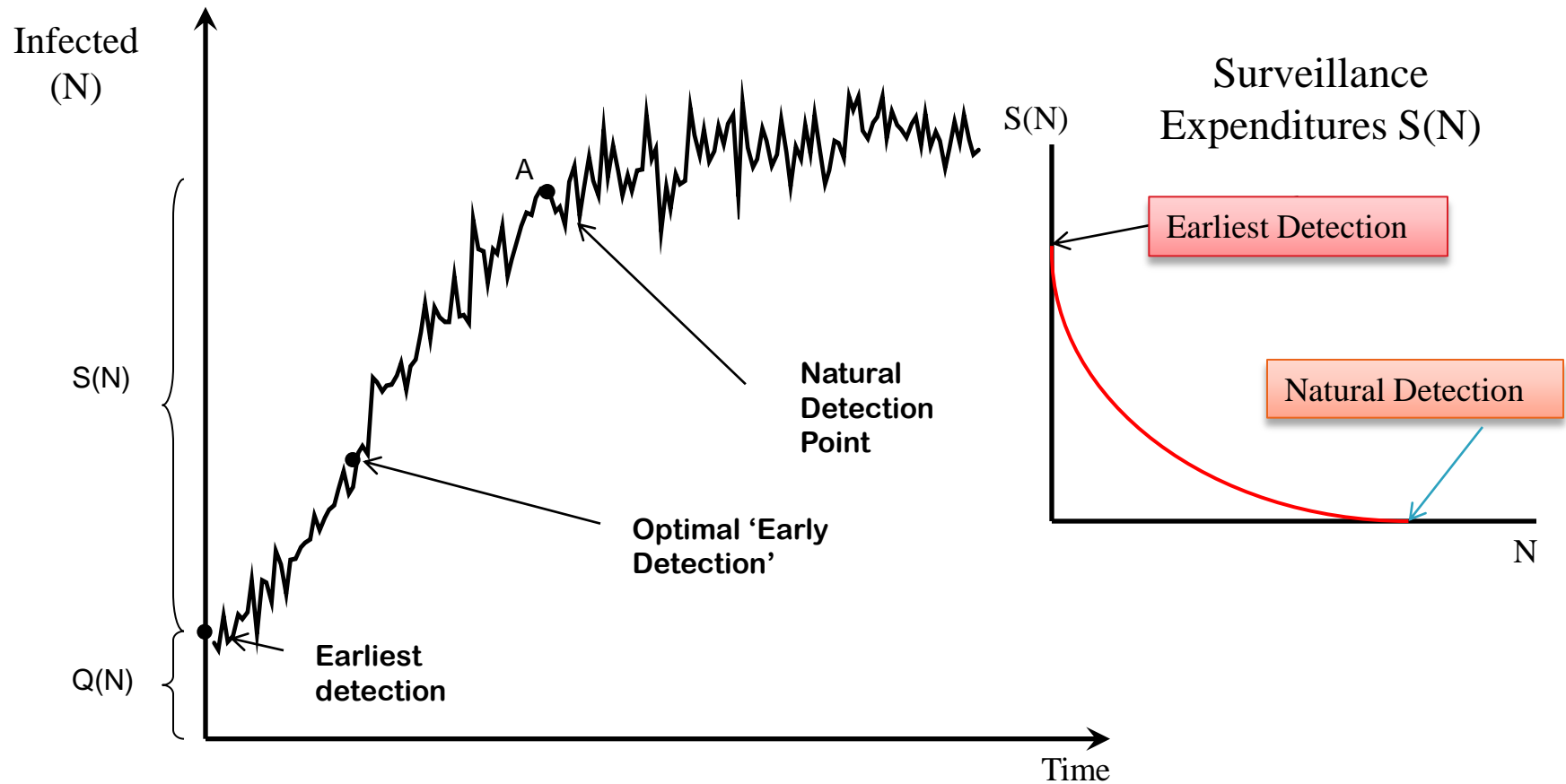


Local Surveillance



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Local Surveillance Measures



Research Design: Optimal Surveillance

- *Benefit*: Surveillance ensures ‘early detection’, lowering economic and environmental losses and pest/disease management costs.
- *Tradeoff*: The more early the detection the more expensive the surveillance measure.
- *Objective*: Find optimal surveillance expenditures to minimize:
 - Economic losses (e.g., plant and animal losses, damage to the environment, biodiversity losses, trade bans, etc.)
 - Eradication and management costs of any pest/disease incursion
 - Surveillance expenditures (e.g. monitoring, the cost of setting and monitoring traps, etc.)
- *Method*: Stochastic (Optimal Control) Bioeconomic Model with a Jump-Diffusion Process.



Hawkweed



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Hawkweed: Tussock and Orange





Hawkweed: MacKenzie Basin, Canterbury

1976

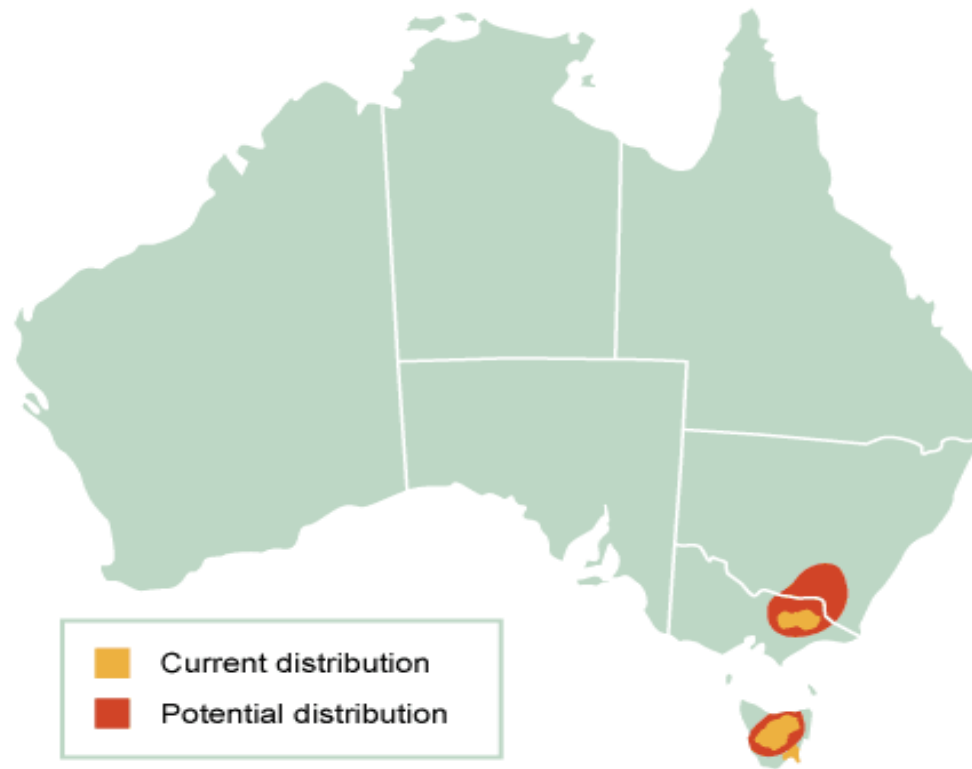


2000





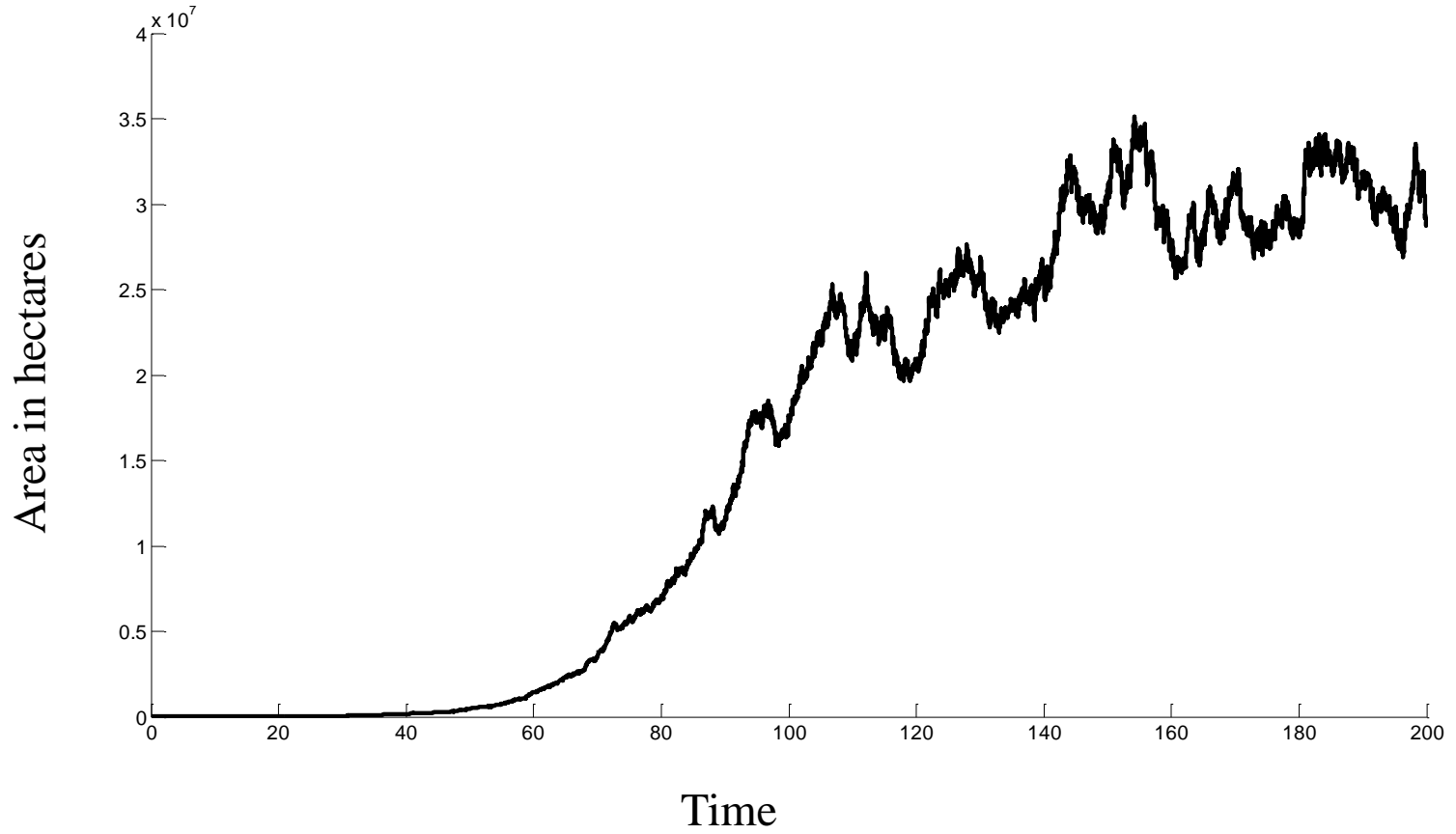
Hawkweed Distribution Map



Current infestation 500 ha - 1000 ha (Williams, Hans, Morgan and Holland, 2007)



Hawkweed spread

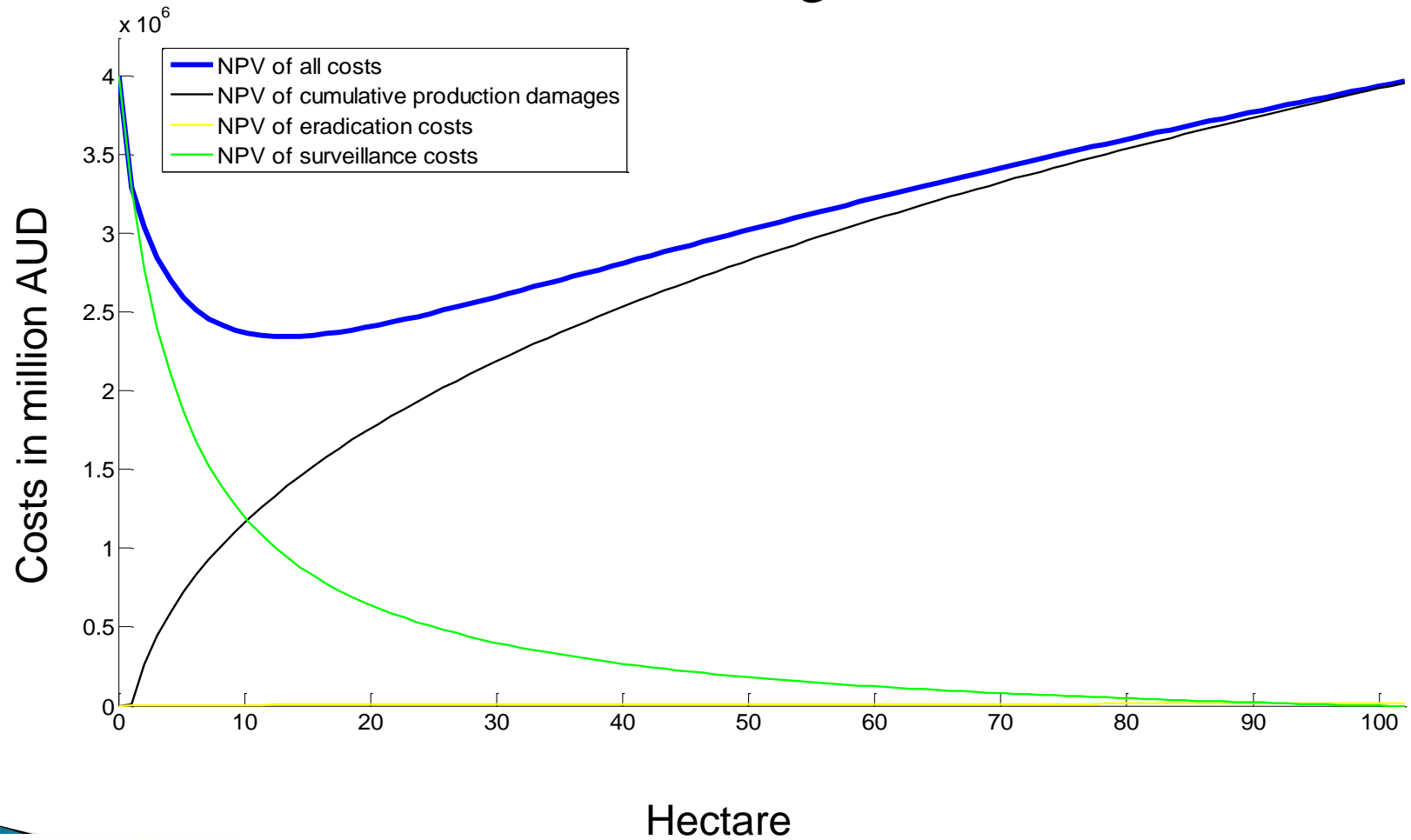




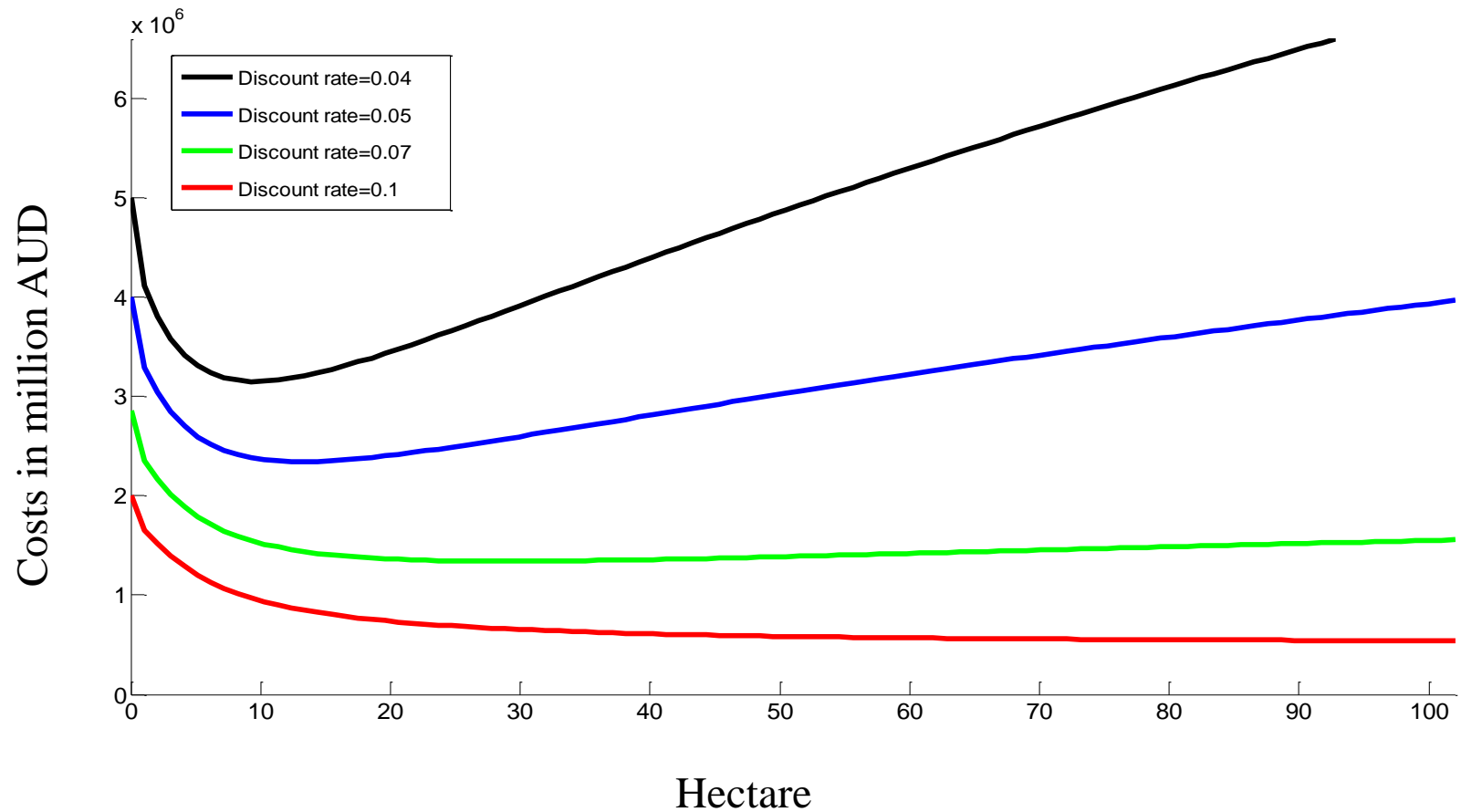
Model Parameters

- ▶ Annual growth rate: 8% - 8.6% (Scott 1993; Johnstone, Wilson and Bremner, 1999); discount rate 5%
- ▶ Maximum Carrying Capacity: 26,996,700 ha (DAFF)
- ▶ Production loss percentage: 15% on improved land and 5% on unimproved land (Grundy 1989)
- ▶ Production loss value: \$60-\$100 ha; \$959 million for grazing; \$289 million for perennial horticulture (1996 land use commodity) (Brinkley and Bomford 2002)
- ▶ Eradication cost: 65 – 83 AUD / ha with multiple treatments (Espie, 2001; Ministry of Agriculture, Food and Fisheries, British Columbia, Canada)
- ▶ Natural detection: 100 ha
- ▶ Maximum annual surveillance cost to detect Hawkweed when the spread is equal or greater than 1 ha: 200,000AUD per year, or approx 4 million NPV over time.

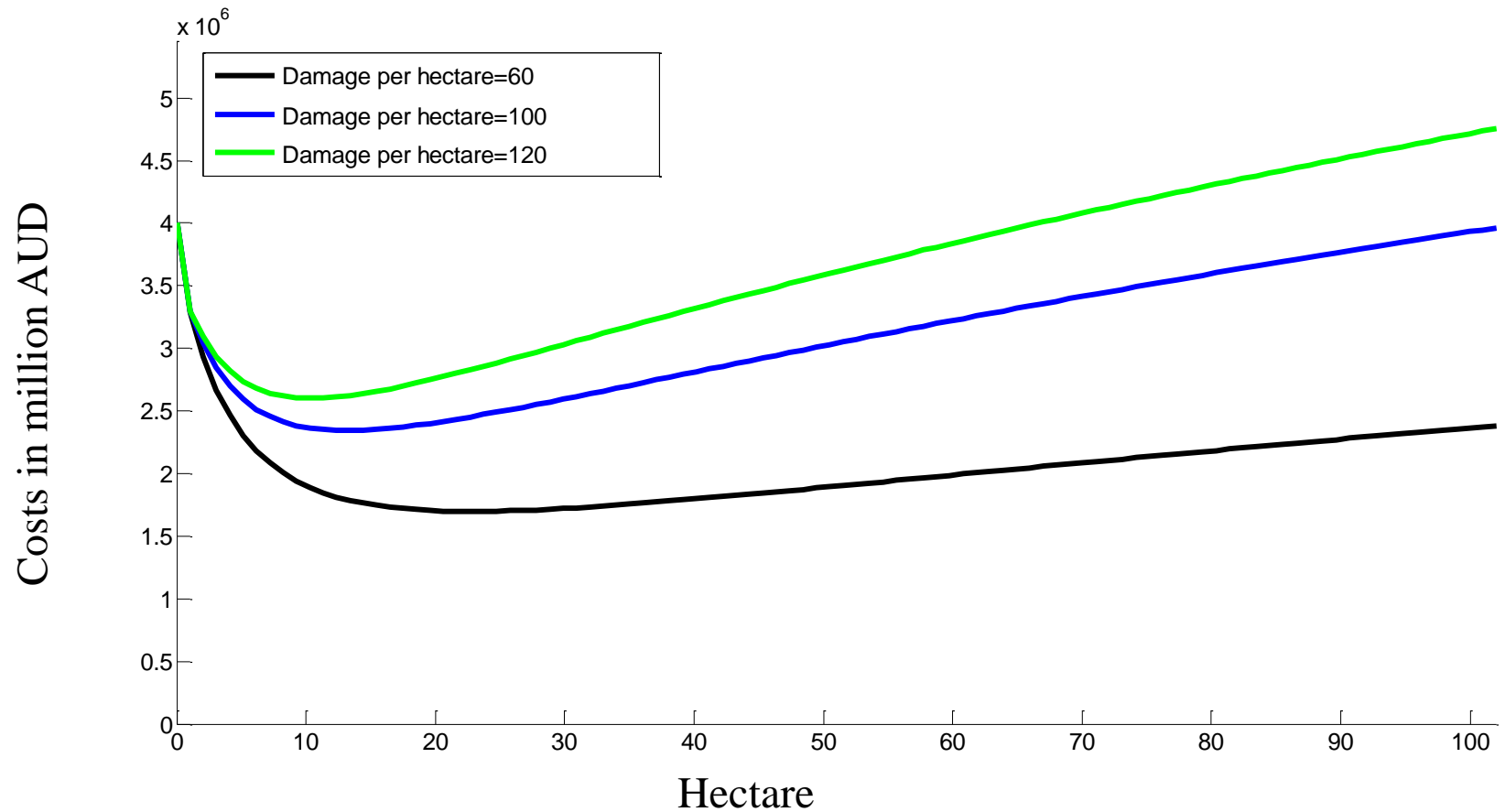
Costs of controlling Hawkweed



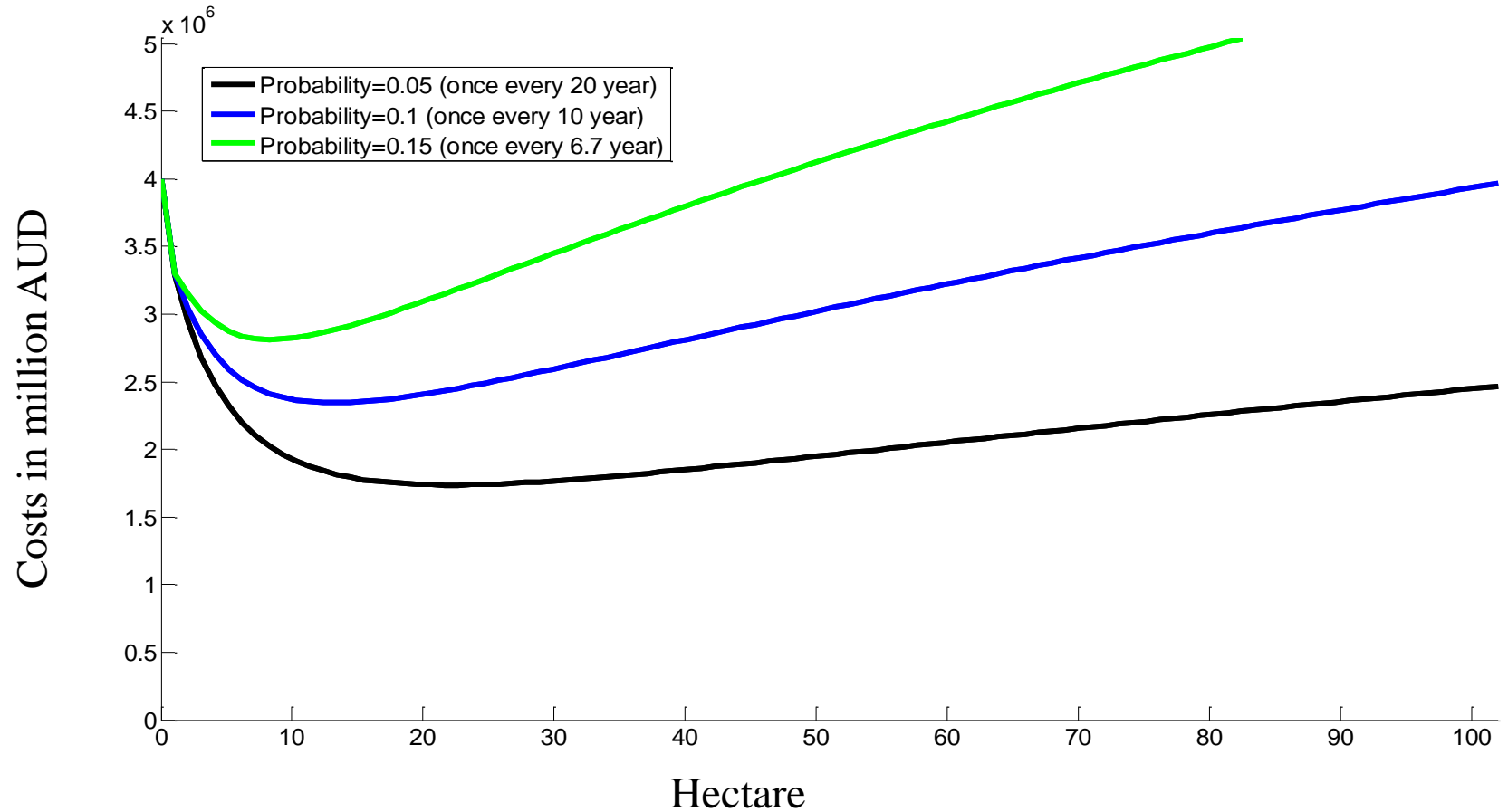
Sensitivity with the discount rate



Sensitivity with the damage per hectare



Sensitivity with the incursion probability



Thorny Issues in CBA for Biosecurity

- ▶ Rate of Discount?
 - Level of rate, time dependent, hyperbolic?
- ▶ Non-Market Valuation?
 - Contingent value, stated preference?
- ▶ Forward Projections?
 - Spatial and density spread? The economics of containment vs. eradication
- ▶ Value of Information?
 - Model selection, parameter estimates, value to precision?



Thanks for listening!

Tom Kompas

tom.kompas@anu.edu.au

<http://www.crawford.anu.edu.au/staff/tkompas.php>

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