The Economics of Biosecurity: Risk, Returns, Quarantine and Surveillance

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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.

Traditional Measures

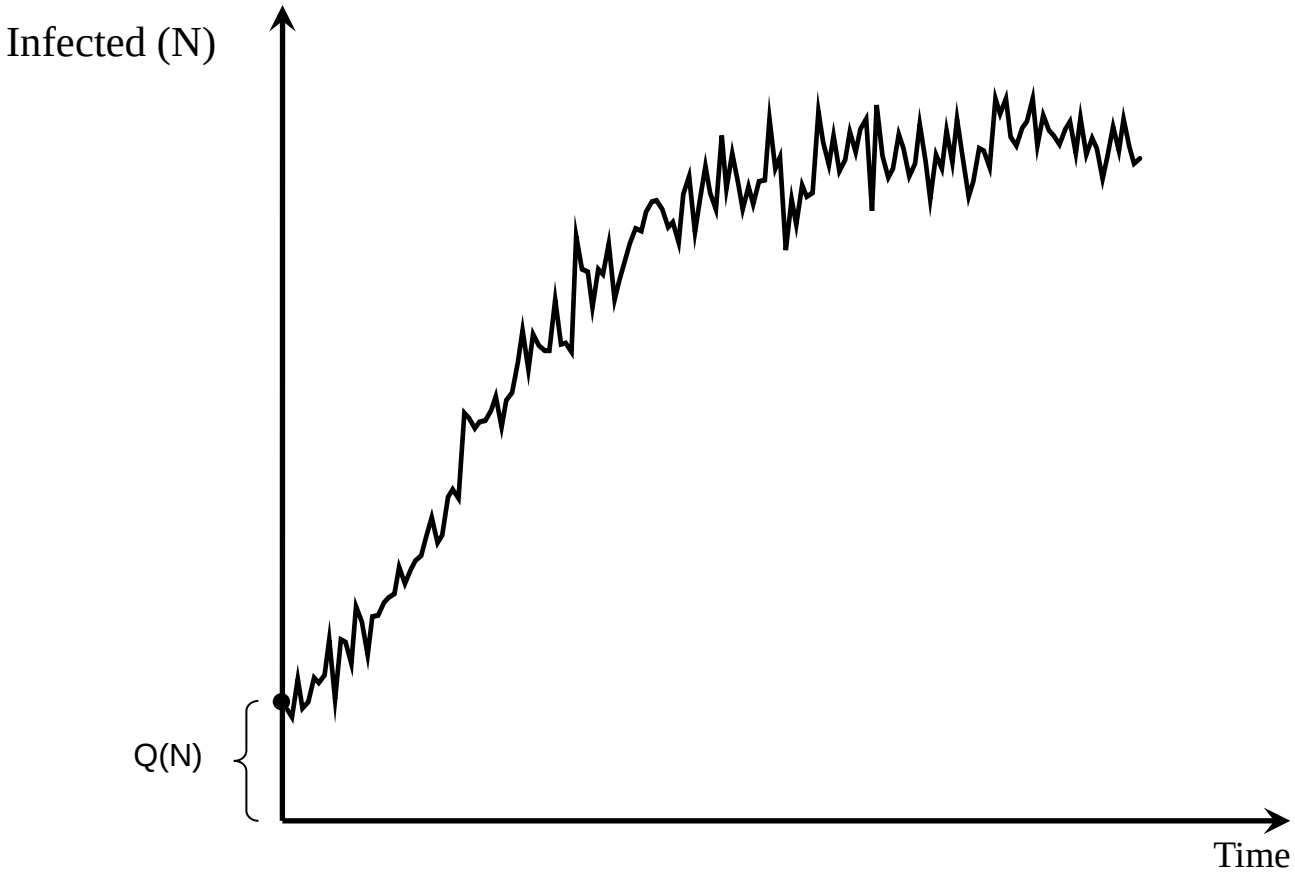
- Pre-border measures and border quarantine (i.e., preventing a potential incursion at the border).
  - Limits on imports
  - Airport inspections, and inspections of shipping containers and contents
- Local surveillance programs (preventing spread in the local environment).
  - Screening and local awareness
  - 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?

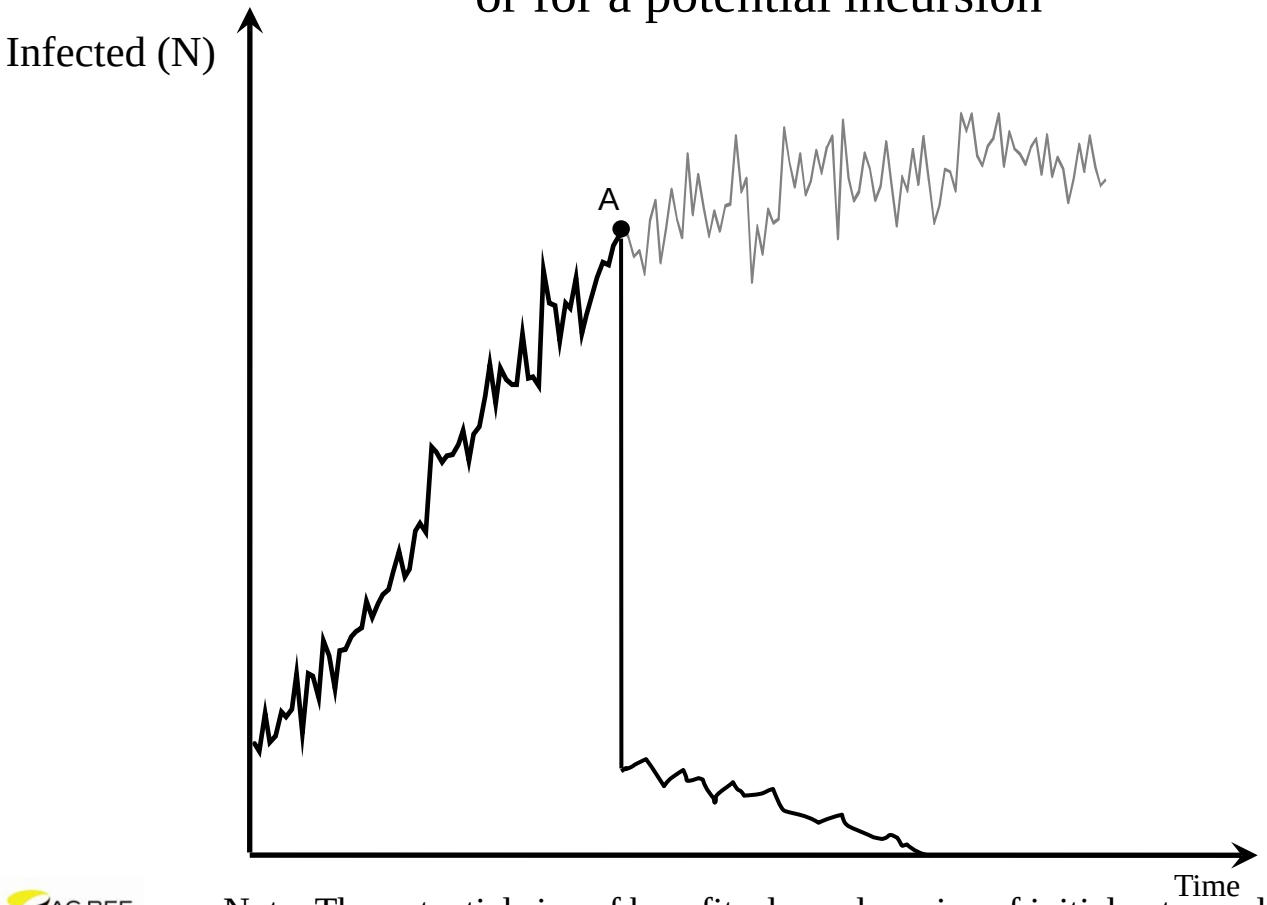
- Ban imports and close airports?
- Spend $0 on quarantine and surveillance?
- Spend all of GDP on quarantine and surveillance?
- Eradicate? Contain? Neither?
- How to allocate resources across various threats?

A Simple Spread Model for an Invasive



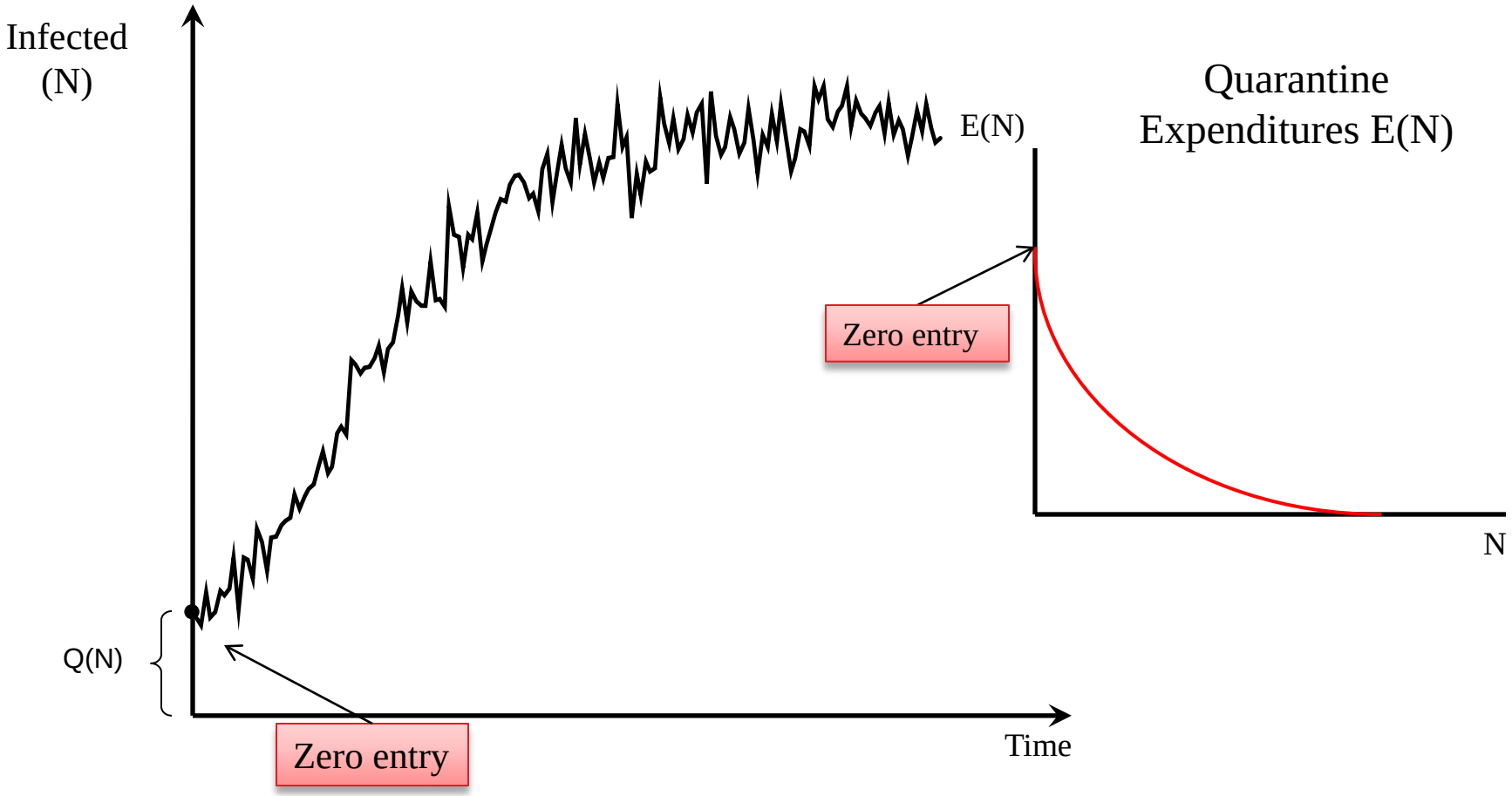
Containment and Eradication

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

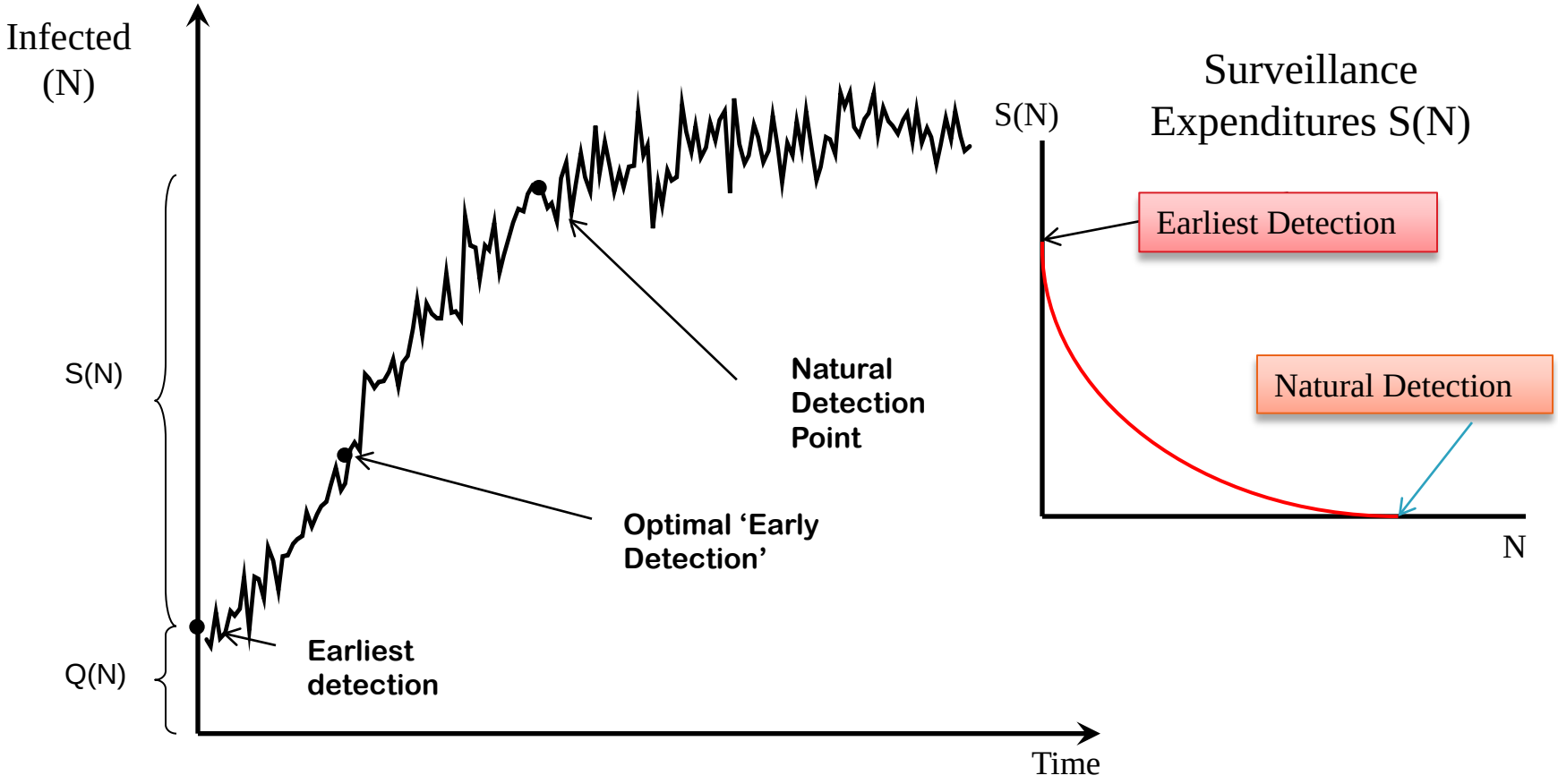


Note: The potential size of benefits depend on size of initial entry and the choice of early detection, for a given eradication/containment exercise.

Border Quarantine Measures



Local Surveillance Measures



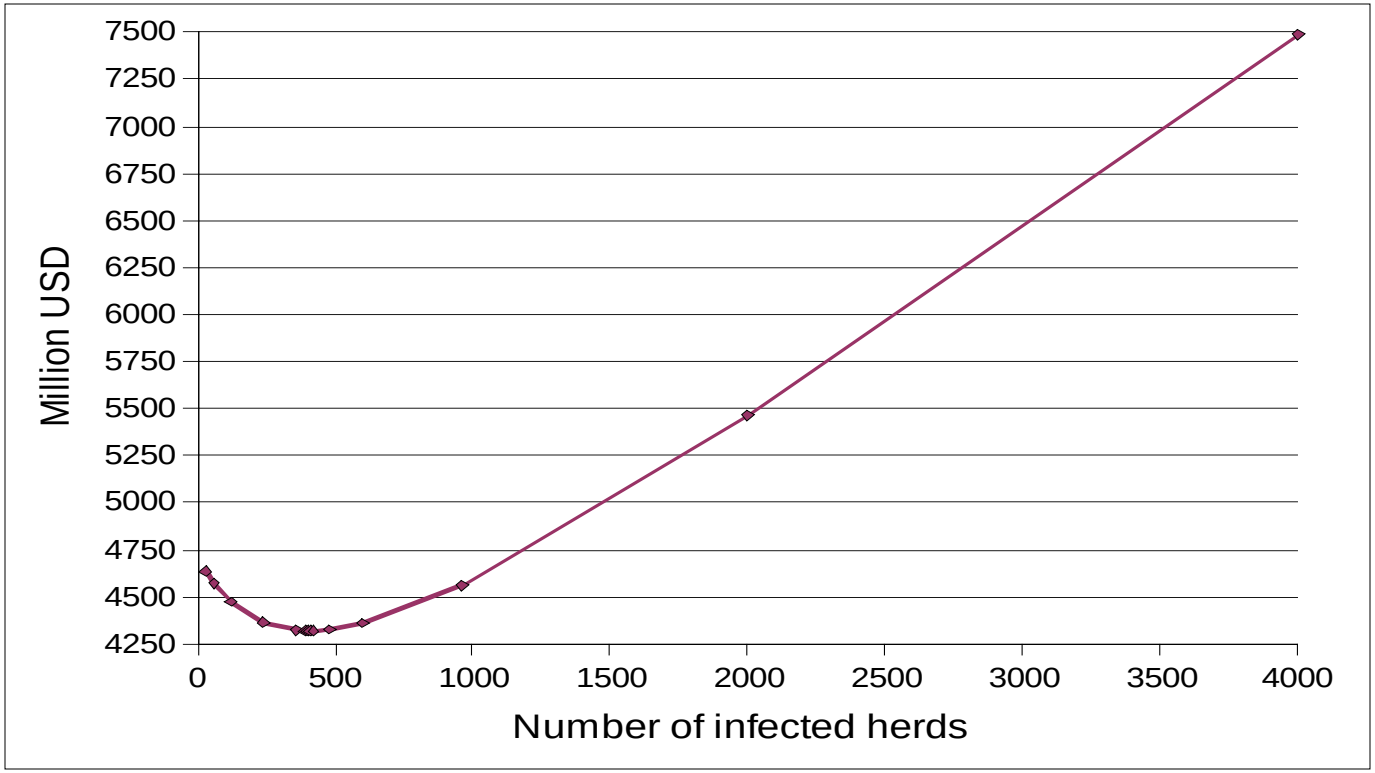
Surveillance Example: Foot-and-Mouth Disease (FMD)

- Foot and Mouth disease (FMD) is a highly contagious disease of susceptible cloven-hoofed animals.
- FMD hosts are typically cattle, sheep and swine, but also can occur in domestic and water buffalos, goats, yaks and zebras.
- The 2001 outbreak in the UK: 8 months of eradication; the losses: about $5 billion in the food and agricultural sectors and comparable amounts in the tourism industry. (GAO 2202)
- Estimates of a potential outbreak in California range form $4.3 to $13.5 billion USD. (Ekboir 1999)

FMD Surveillance (cont)

- Incursion, biological and economic parameters: the United States General Accounting Office (GAO 2002) and Bates et al. (2001, 2003a, 2003b).
  - Incursion: 1 in 30 year event.
  - Natural detection: 4000 herds.
  - Maximum expenditure: 2000 blood tests (200 current); $82.9 million ($8.29 million current).
  - Average production loss per head: 0.224; trade and tourism: 0.1 and 0.005
  - Eradication zone: 8 times radius of infected infected herds; eradication and vaccination parameters: 0.018 and 0.00296.
  - Minimum trade ban: 24 weeks, beta is .008
- Sensitivity tests: probability of incursion; growth of transmission, density growth, eradication zone, average production loss.

Optimal Surveillance Grid and Expenditures (FMD)



Optimal: 405 potentially infected herds and $S^*(h)$ = $43m/year(US)

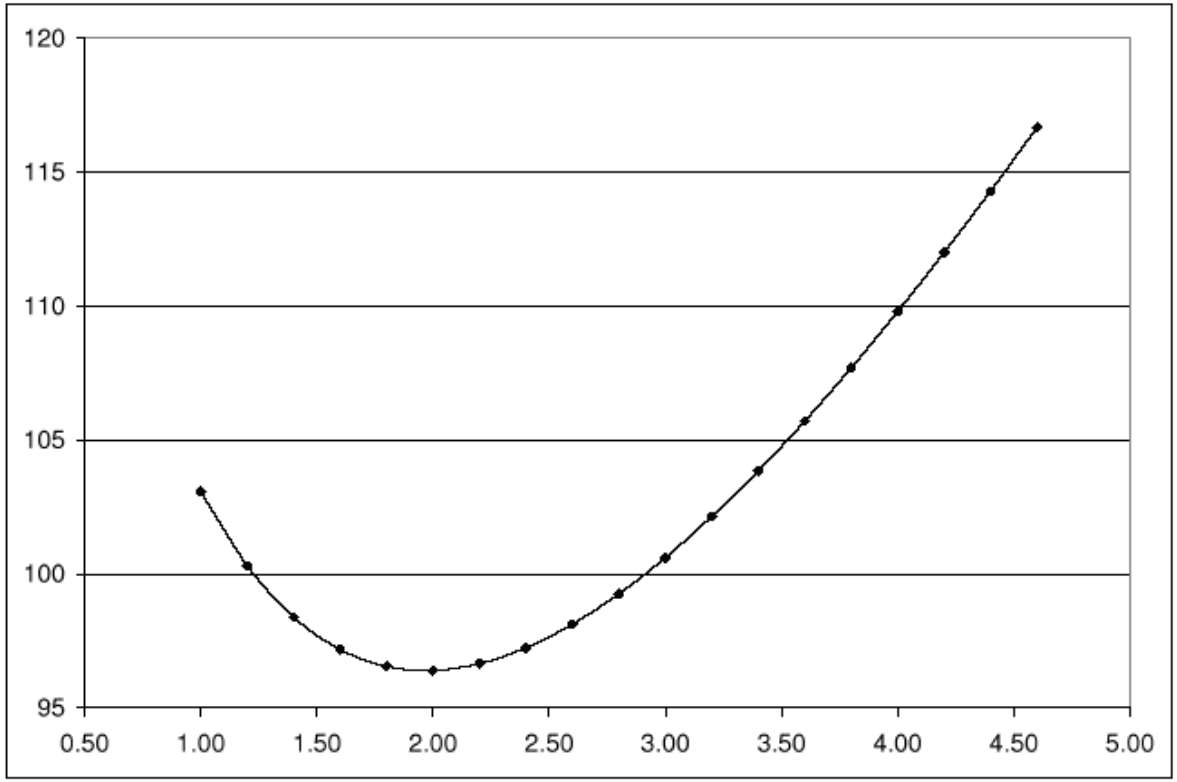
Current USA: $8.29m/year and 2000 potentially infected herds

Natural detection is 4000 herds

Surveillance Example: Papaya Fruit Fly (PFF) in Australia

- PPF attacks fruit and habitat, and in early stages is difficult to detect by inspection (boarder quarantine is limited and ineffective).
- Largest risk of entry: via the Torres Strait Islands and at ports of entry.
- 'Current' surveillance grid: 1 trap for every 6,200 km^2, 1,878 traps in total, Current Expenditures = $1,380,000 (including the program's fixed costs).
- 1995 outbreak in QLD: $43m in eradication and management costs over a 13 month period.

Optimal Surveillance Grid and Expenditures (PFF)



Optimal: one trap per 2,000 km^2 and $S^*(h)$ = \$3m/year(AUS)

Current: \$1.38m/year: Current surveillance grid: 6,200 km^2

Thanks for listening!

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