De-Forestation of a Nation: Estimating the Economic Impact of Pitch Canker in Australia

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The red colored areas on this map are expected to lose more than 25% of their ornamental and native Monterey pine trees due to pitch canker. In these areas, Monterey pine trees are currently dying from pitch canker and actual losses may be much greater than 25%. Knobcone pine and bishop pine are also infected with pitch canker and are also expected to die but the mortality rate for these species are not known.

The Approach

- Frequentist probability theory approach, probability distributions rather than point estimates
- The objective of the model is to assess the significance of the threat posed by *F. circinatum* by determining its total *expected* (or probability-weighted) damage over a specified period of time.

The Approach

- Monte Carlo simulation samples from specified distributions.
- Each parameter is estimated as a probability distribution
- 10,000 iterations of the model run in which one value is randomly sampled across the range of each distribution.

The Approach

- The model depends on the probability of introduction in any particular time period (a Markov process), the rate of spread (by a diffusion process) from one site to satellites and beyond and the amount of damage (dependent on area and fungal density) expressed in present value terms.

The model

- Present value of expected damage is:

$$\mathrm{PV}(\mathrm{ED}_n) = \sum_{t=0}^{n} (1+\alpha)^{-t} . \sum_{j=1}^{s_t} p.d.\mathrm{A.N}$$

- p – prob of establishment (Markov process)
- d – damage
- A – area
- N – density of fungus
- **α** - discount rate

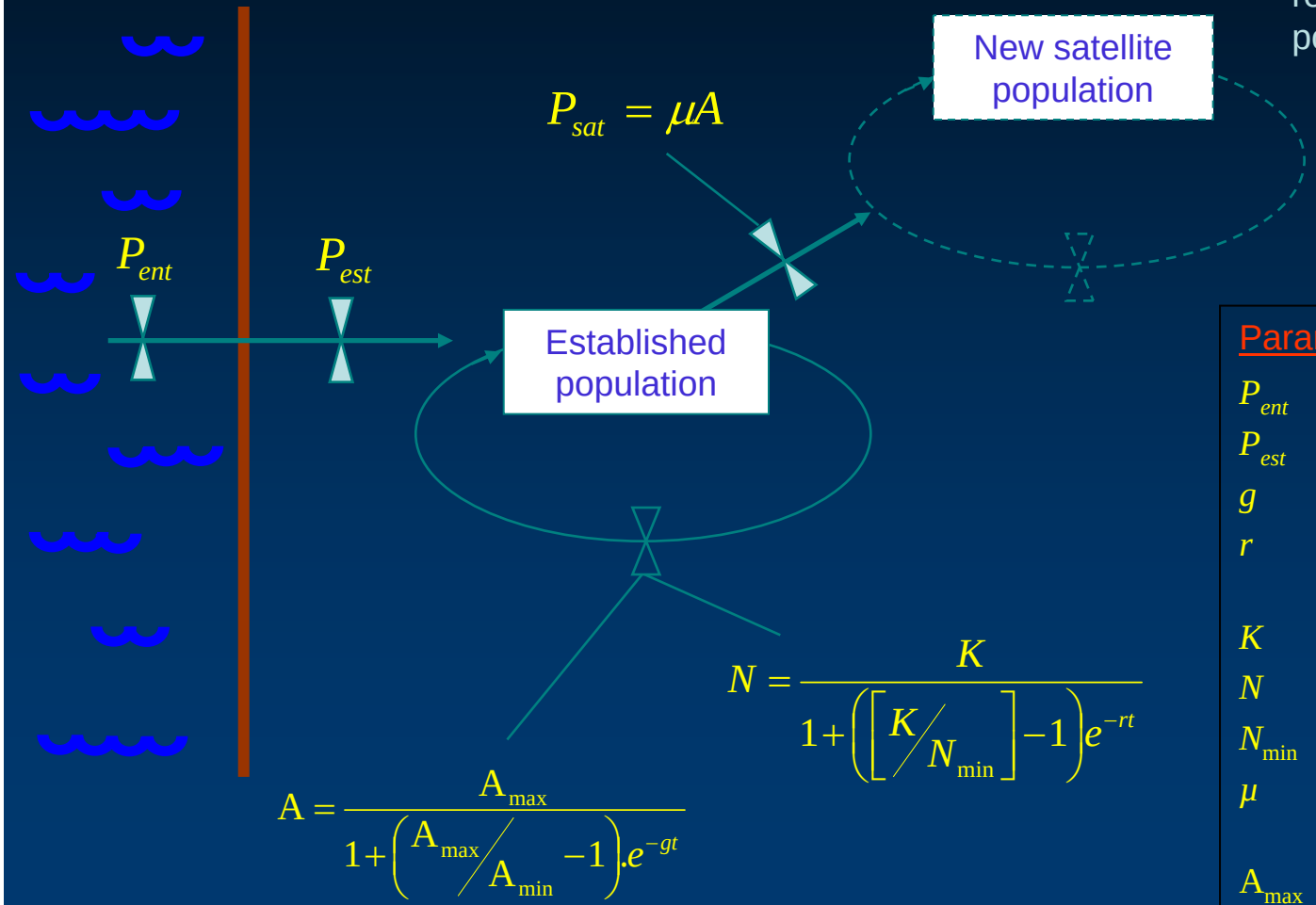
This is a probability weighted estimate of *F. circinatum*-induced revenue losses to the radiata crop over time. It provides a measure of the significance of the threat posed by the pest to Australia's biosecurity system. It is *not* a measure of what damage will be inflicted by *F. circinatum* if it is introduced to Australia tomorrow

$$PV(ED_{n}) = \sum_{t=0}^{n} (1+\alpha)^{-t} . \sum_{j=1} p.d.A.N$$

- We assume losses in average stands of around 15 per cent in the long term (i.e. if the disease becomes naturalised). Damage is expected to be up to 30 per cent in stands between 0 and 10 years of age, while damage to older stands (20-35 years) is likely to be negligible.

Economic Impact Assessment

NATIONAL BOUNDARY

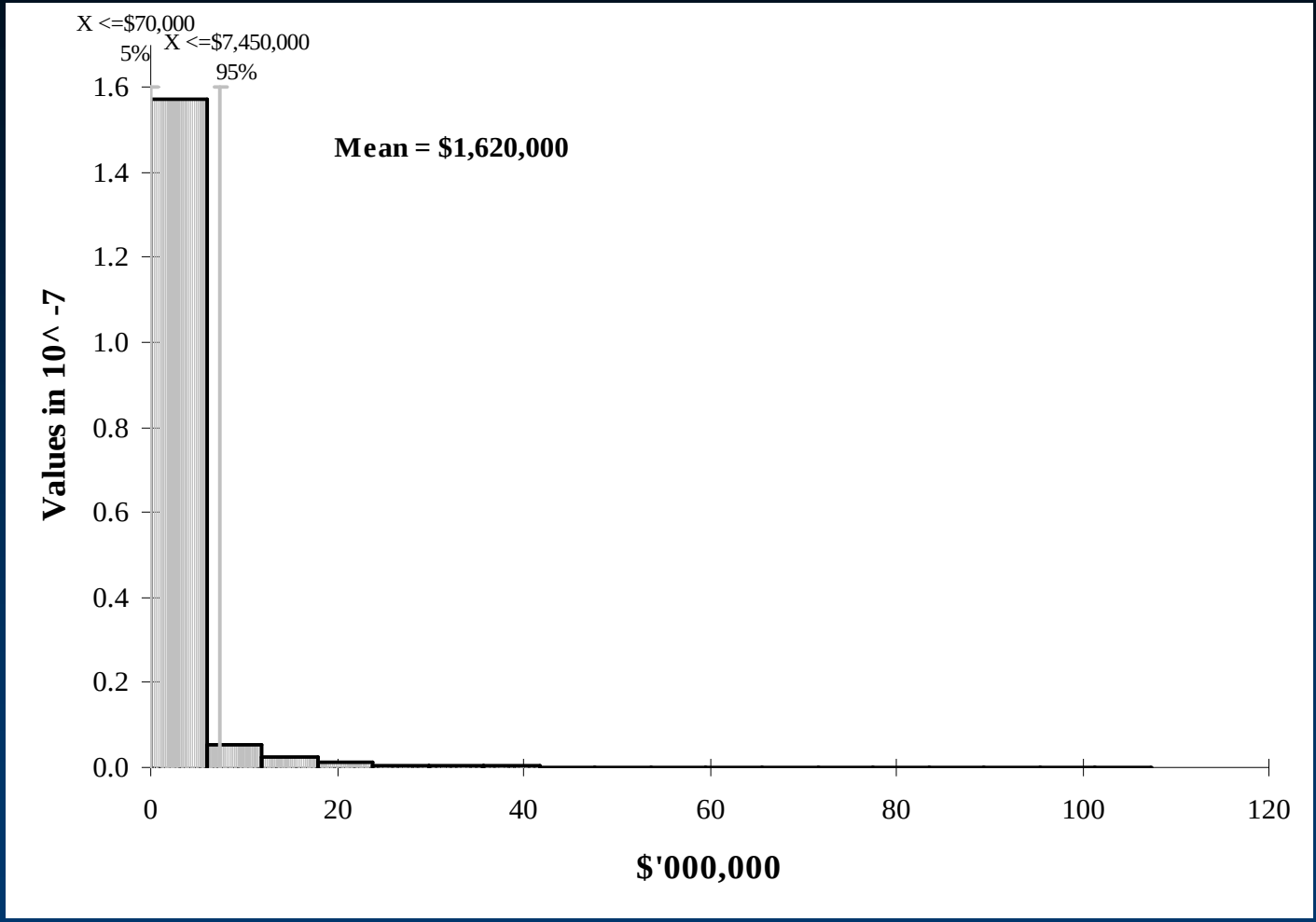


Total area summed across all satellites increases until reaching $A_{max,}$ at which point it remains constant

Parameters:

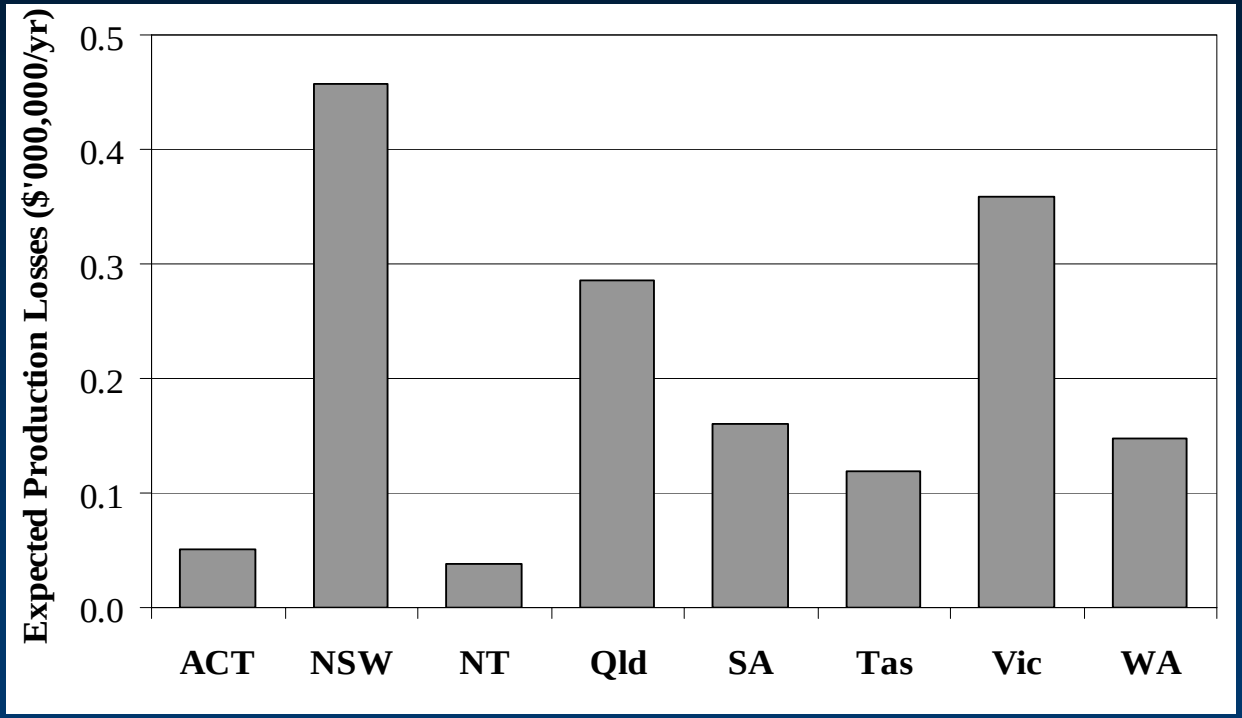
P_{ent}	- Entry probability
P_{est}	- Establishment probability
g	- Rate of population growth
r	- Intrinsic rate of density increase
K	- Carrying capacity
N	- Local population density
N_{min}	- Density upon arrival
μ	- Rate of new satellite generation
A_{max}	- Total host area
A_{min}	- Initial area affected

Results



the expected producer surplus losses avoided through successful exclusion are around $1.62 million per year, 90% CI = $0.07m - $7.45m

Distribution of possible losses



Discount rate sensitivity