Optimal control of a stochastic biological invasion

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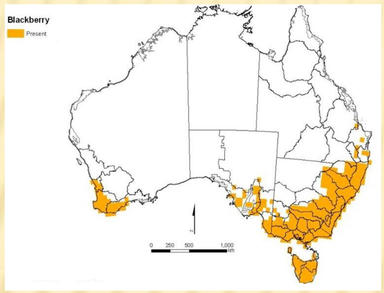
Introduction:

Blackberry infests many natural ecosystems in many countries including Australia (e.g. Pemberton 2000).

Blackberry is considered as one of the worst weeds in Australia due to its invasiveness and environmental and economic impacts (Reid 2008).



There have been studies that have considered the economics of environmental weeds and pests (e.g. Odom *et al.* 2003; Cacho *et al.* 2007) but they did not study a large number of decision options.

In this paper we consider a large number of discrete control strategies that enables us to look at a list of Integrated Weed Management (IWM) strategies.

Research questions:

- What are optimal strategies to control blackberry in different circumstances?
- Are Integrated Weed Management strategies always superior to chemical-only strategies?
- How changes in model parameters affect optimal decision options?

Model:

Two different models are developed and applied:

(a) A stochastic dynamic simulation model that represents weed infestation as a stochastic process.

(b) A stochastic dynamic optimisation model.

Blackberry causes losses of social welfare in at least three ways:

- By obstructing people who wish to swim in the river.
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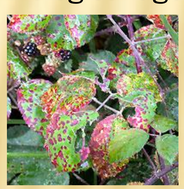
- By obstructing fishers from using some of the river bank.
- By competing with native plants and degrading native habitat.

8 control options are considered:

Biological agent *Chemicals* *Mowing* *Grazing goats*



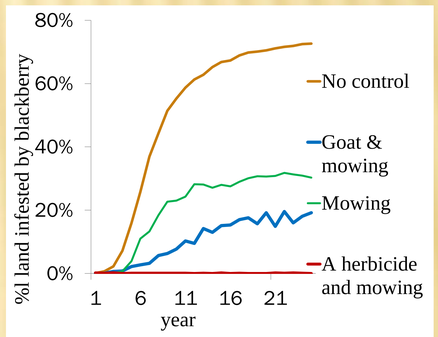
All possible combinations of theses options are considered.

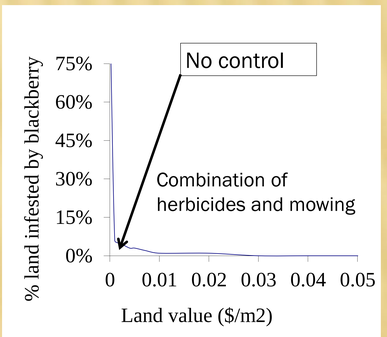
The optimisation model finds the optimal control strategies in different circumstances.

Results and conclusions

Results show

- In most circumstances combination of a herbicide with mowing is optimal.
- The optimal strategy is not sensitive to change in land values. Only for very low land values is “no control” optimal.
- Integrated strategies are not necessarily better than single control options.





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