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Demonstrating return on investment

Optimal monitoring and adaptive management

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The aim of this talk

- Reinforce the role and importance of monitoring in environmental management:
  - Learning and improvement
  - Evaluating and demonstrating return on investment
- Highlight the changes to monitoring theory and practice arising from AEDA research
- Explore future applications of optimal monitoring relevant to DEWHA

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Structure of the talk

Why monitor?

1. Where is all the adaptive management?
2. A new discipline: active adaptive management
3. AEDA and optimal monitoring: in brief

The future of optimal monitoring and DEWHA…

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Why monitor?

- Monitoring to drive management actions
- Monitoring to learn about a system
  - effectiveness of actions
  - the way the world works (monitoring for science)
- Monitoring to involve and inform the public
- Monitoring to audit management decisions
- Serendipity monitoring
- Omnibus strategies

Joseph L., et al. (in review). Optimal monitoring for conservation. *Conservation Biology.*

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1. Where is all the adaptive management?

Monitoring to learn about the effectiveness of actions: native vegetation restoration

LANDSCAPE LOGIC

Victoria Department of Sustainability and Environment

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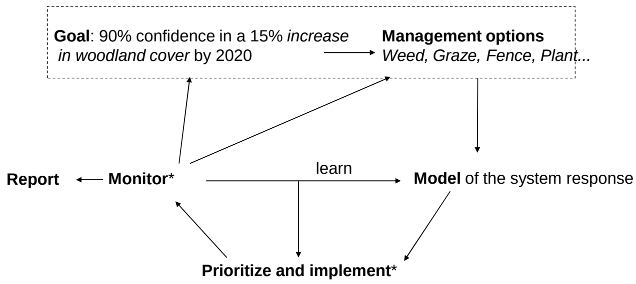
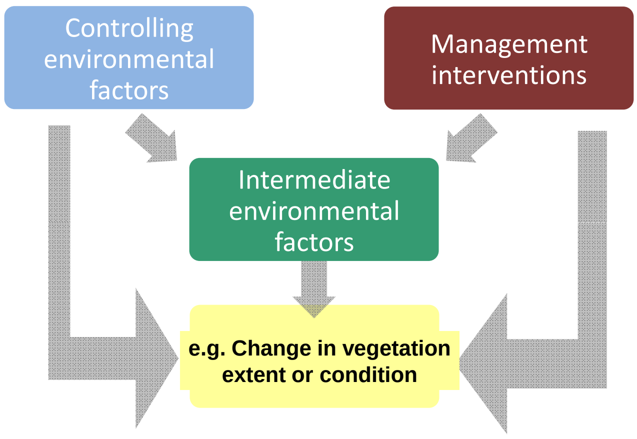
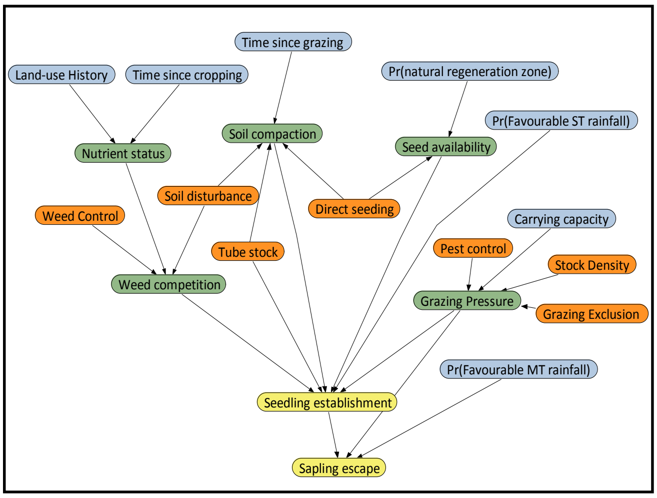
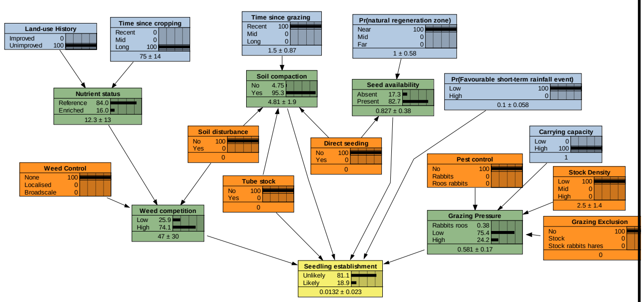
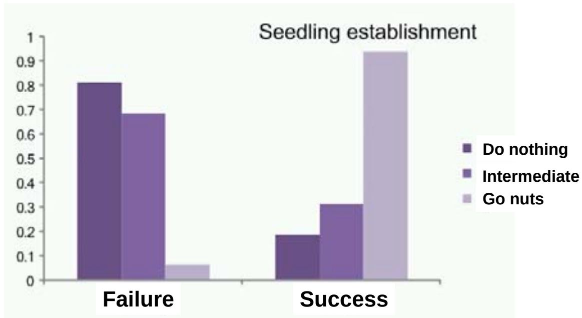


Duncan, D., and B. A. Wintle. 2008. Towards adaptive management of native vegetation in regional landscapes. *in* C. Pettit, et al., eds. Landscape Analysis and Visualisation. Springer.









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Which projects should we fund this year?

$$\text{Cost Efficiency}_i = \frac{\text{Expected Benefit}_i(\Delta\text{seedling establishment})}{\text{Cost}_i(\$)}$$

Project	Success Probability	**Benefit** (Ha)	**Cost** NPV$_{50}$	Efficiency (W*P*B)/C
Fence Farm A	0.8	50	300K	0.13
Buy Farm B	0.8	50	1.0M	0.04
Weed Farm C	0.4	20	700K	0.01
etc…				

Joseph, L. N., *et. al.* 2008. *Conservation biology*

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Monitoring and model updating

Bayes nets are easy to update with case files

- not all nodes must be monitored in each case or at each time step
- multiple competing models can be considered
- data need not arise from statistically designed studies

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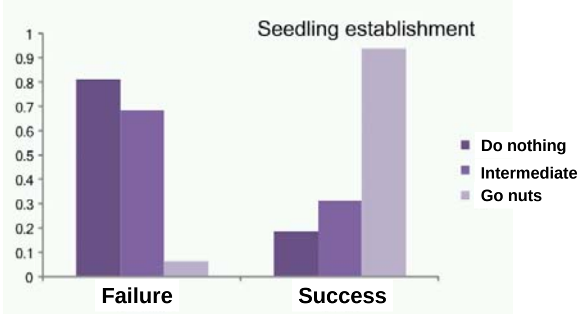

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Rumpff L.,et. al. (in press) Adaptive management of native woodlands. *Biological Conservation*.

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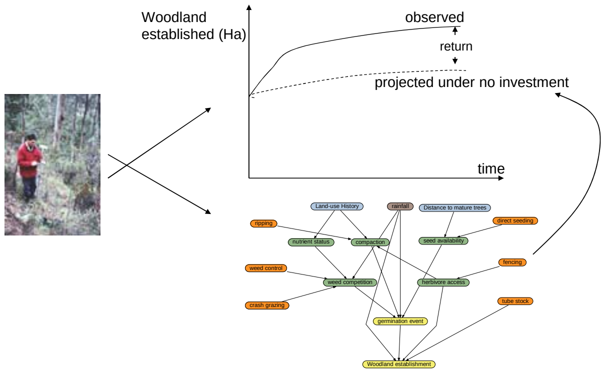

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2. A new discipline: *Active* adaptive management

Optimal management and monitoring of devils and tigers

Chades I., *et al.* (2008) Save, survey or surrender: optimal management of a cryptic threatened specie. *PNAS*.

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Active and passive adaptive management

- *passive:* best action given current knowledge (with a plan to update knowledge as information arises)
- *active*: manipulate the system to learn more quickly (and do better in the long-run).
  explicitly allows for doing to learn apparently sub-optimal things in order more quickly

McCarthy M.A. & Possingham H.P. (2007) Active adaptive management for conservation. *Conservation Biology*, 21, 956-963

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How can we actively learn system function? - a devilishly difficult dilemma

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How can we actively learn system function? - a devilishly difficult dilemma

- Objective : Maximise population growth
- Decrease prevalence
- Removal of individuals
- 2 sites for feasible learning

McDonald-Madden *et al (in press) Active conservation of threatened species in the face of uncertainty. Ecological Applications.*

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A devilishly difficult dilemma - actions?

- Many facets unclear
- Latency affects removal
- Short – remove diseased
- Long – remove all
- Removal affects reproduction and prevalence

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Models and Actions

		model 1	model 2	model 3
		Disease will not progress	short latency	long latency
action 1	No treatment	1.20	0.9	0.9
action 2	Cull all diseased	1.05	1.15	0.95
action 3	Cull all adults	1.01	1.01	1.01

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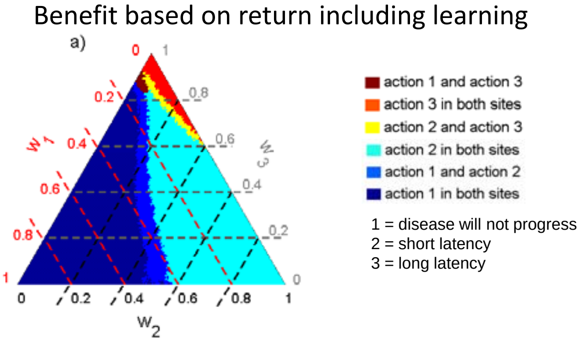
Benefit based on return including learning



McDonald-Madden *et al (in press) Active conservation of threatened species in the face of uncertainty. Ecological Applications.*

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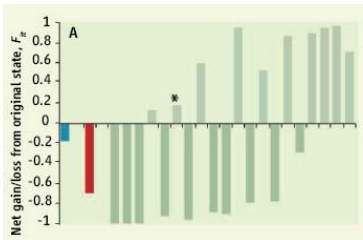
In brief....

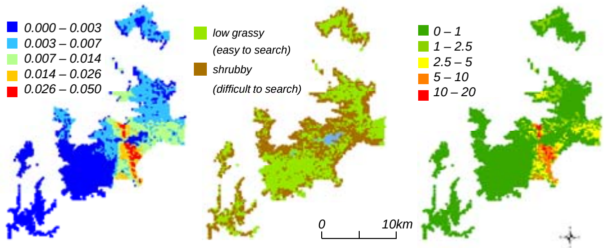
- Honest Reporting



$$F_{it} = \frac{s_{it} - l_{it}}{s_{it} + l_{it}}, \quad -1 \le F_{it} \le 1$$

McDonald-Madden et al. (2009). "True" conservation progress. *Science*

In brief… Optimal surveillance of weed incursions



Map 1. *Predicted probability of orange hawkweed occurrence* ***Map 2.*** *Vegetation categories* ***Map 3.*** *Optimal search time (minutes per 4ha site)*

Hauser C.E. & McCarthy M.A. 2009. Streamlining 'search and destroy': cost effective surveillance for invasive species management. *Ecology Letters* **12**: 683—692.

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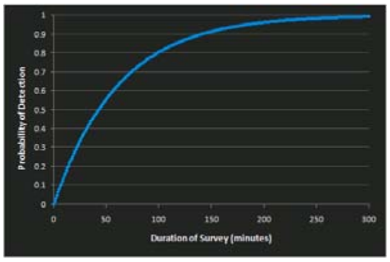
In brief….

- Plant species detectability



Garrard et al. (2008). When have we looked hard enough? A novel method for setting minimum survey effort protocols for flora surveys. *Austral Ecology*.

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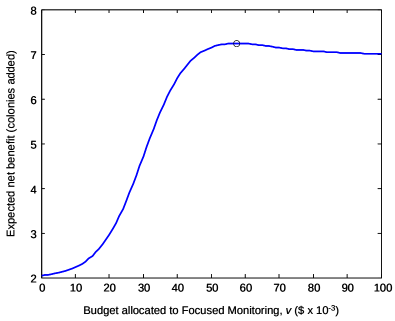
In brief….

- Serendipity monitoring



Wintle, Runge, Bekessy (in review). Efficient monitoring of the unknown unknowns. *Ecology Letters.*

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Conclusions

- Monitoring is a critical activity in environmental management:
  - Learning and improvement
  - Evaluating and demonstrating return on investment
- AEDA has been at the centre of developments in optimal monitoring theory and practice

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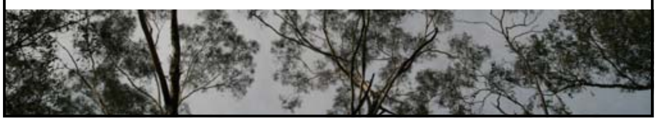
Future research directions

- Workable strategies for monitoring return on Caring for Country investment (challenges – broad scale, incommensurate value)
- Apply developments in AAM to big conservation problems (e.g. translocation as a viable climate change adaptation strategy)



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