Applied Environmental Decision Analysis (AEDA)

A Commonwealth Environment Research Facility

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The University of Queensland Australia

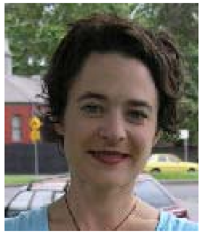
The University of Melbourne

Australian Government
Department of the Environment and Water Resources

ANU
The Australian National University

RMIT University est. 1887

Hugh Possingham
(Director)



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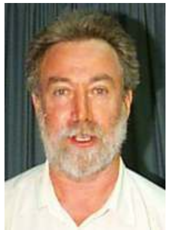

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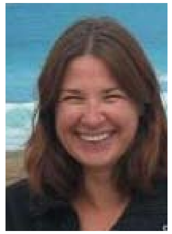

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David Lindenmeyer

Mark Burgman

Bob Pressey

Karen Hurley
(Business Manager)

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Organized into three nodes

- Queensland (UQ) – Possingham (Director)
- Canberra (ANU) – Lindenmayer
- Melbourne (UM) – Wintle
- ~ 100+ Associated PDs, PhDs + listed researchers
- Knowledge Broker – David Salt

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Three themes

1. Systematic prioritization
2. Monitoring/Adaptive Management
3. Decisions under uncertainty

} Decision Theory

$EV_i = (pr_i * Benefit_i)/C_i$

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1. Systematic prioritization

Key question: Which prioritization of investment best achieves management objectives? (eg. Joseph et al. in rev. *Cons Biol*)

Project (threat rank)	Probability M*N	Benefit $P_i - P_0$	Cost NPV_{50}	Value*100 (W*P*B)/C
Wood Rose (27)	0.8	0.5	300K	0.13
Black Robin (8)	0.8	0.5	1.0M	0.04
Otago Skink (13)	0.4	0.2	700K	0.01
etc…				

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Results

1. Protect more species when you incorporate cost and probability of success.
2. Higher expected gain when prioritization is based on efficiency rather than threat (almost double the number of species protected)

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1. Systematic prioritization

Other Examples:

1. Rezoning the GBR (Marxan)
2. Prioritizing conservation in urban fringe Melbourne (Zonation)
3. NRM prioritization in WA (Romula Stewart)

Key concept:

Additive indices are misleading: force ≠ mass + acceleratn (Possingham *pers. com*. 2007)

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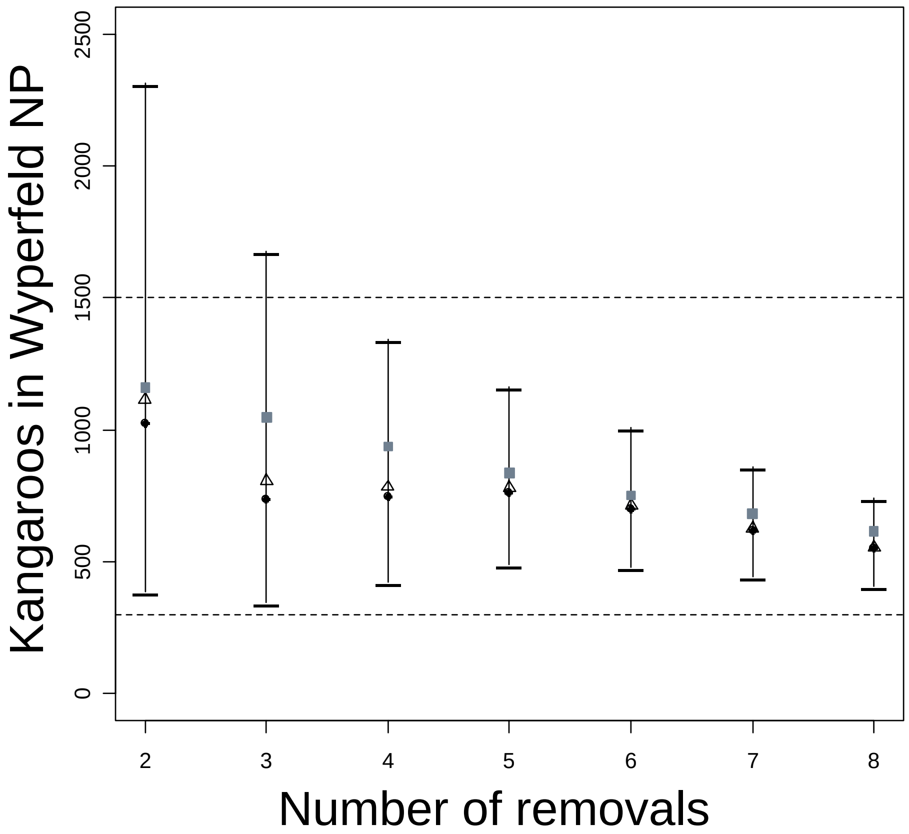
2. Monitoring and Adaptive Management

Key question: What monitoring investment do we need in order to manage well (to make a good decision)?



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2. Monitoring and Adaptive Management

Other Examples:

1)Monitoring to evaluate the performance of investments in native vegetation restoration/river restoration (Duncan/Wintle)

2)Monitoring for the effectiveness of Mallee Fowl management (Wintle/DSE)

3)Monitoring and control of weed invasions in Alpine National Parks (Moore/Parks Vic)

Key Concept: Clear specification of management goals, management options, performance measures, and competing models are central to adaptive management.

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Making monitoring meaningful

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Abstract Conservation monitoring in Australia has assumed increasing importance in recent years, as societal pressure to actively manage environmental problems has risen. More resources than ever before are being channelled to the task of documenting environmental change. Yet the field remains crippled by a pervasive lack of rigour in analysing, reporting and responding to the results of data collected. Millions of dollars are currently being wasted on monitoring programmes that have no realistic chance of detecting changes in the variables of interest. This is partly because detecting change in ecological systems is a genuinely difficult technical and logistical challenge. However, the failure to plan, fund and execute sophisticated analyses of monitoring data and then to use the results to improve monitoring methods, can also be attributed to the failure of professional ecologists, conservation practitioners and bureaucrats to work effectively together. In this paper, we offer constructive advice about how all parties involved can help to change this situation. We use three case studies of recent monitoring projects from our own experience to illustrate ways in which the disconnect between science and bureaucracy can be bridged and some obstacles to collecting and analysing ecologically meaningful data sets can be overcome. We urge a continuing discussion on this issue and hope to stimulate a change in the culture of conservation monitoring in Australia.

Key words: conservation, management, sampling design, statistical analysis, statistical power.

INTRODUCTION

As the science of conservation biology matures, its focus is naturally moving towards applying its newly developed principles to the task of actively managing and restoring landscapes. In this respect, Australia is an intensive laboratory; its temperate woodlands, grasslands and freshwater systems have been massively degraded since European settlement, and tens of millions of dollars each year are now being directed at rehabilitating many regions in its southern agricultural zone. Starting with the Natural Heritage Trust (NHT) in 1997 and continuing with the National Action Plan for Salinity and Water Quality (NAP), more than $3.7 billion of investment from the Australian Government (with approximately equal investment from State Governments) has now been committed to programmes aimed at environmental restoration. This large amount of investment through only a few programmes provides one of the world's most promising opportunities for gathering knowledge about the efficacy of different management strategies and the utility or otherwise of the principles of conservation biology.

Ecological monitoring is an indispensable tool for capitalizing on this opportunity. Without rigorously quantifying the state of a system before and after a management intervention, we are left unable either to defend the decision to intervene, or to assess the efficacy of the action. Therefore, when the dust settles on the current flurry of management activity, we may find ourselves in an invidious position unless we can draw on effective monitoring data to demonstrate what has been achieved through our successes and learned through our failures. This points to the importance of not only implementing conservation management actions, but also purposefully working towards the ability to report on their outcomes. Thus far we have been faced only with the 'what happened to the money?' question. Some years down the track, however, it is likely to be followed by the more difficult, searching enquiry 'what good did it do?'.

If that question were to be asked today, we would have very little to report. The first phase of the NHT devoted scant resources to monitoring, emphasizing a multitude of small-scale uncoordinated on-ground actions, to the near-exclusion of setting up frameworks

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Use of confidence intervals to demonstrate performance against forest management standards

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Abstract

The objective of continuous improvement embedded in forest management standards relies on the capacity of management to respond appropriately to evidence of performance provided by monitoring. This evidence is rarely unequivocal. Under a null hypothesis of no effect, two kinds of errors in interpretation are possible—inferring an effect where none exists (Type I error) and inferring no effect when in fact one exists (Type II error). If the monitoring relates to possible improvement in growth or yield then a Type I error leads to false optimism and a Type II error to false pessimism. If monitoring concerns a potential environmental or social impact, a Type I error implies alarmism and a Type II error a false sense of security.

Explicit consideration of statistical power in designing and interpreting monitoring data is an effective buffer against these errors. However, strict application of statistical power may be impractical. In particular, the requirement to specify tolerable error rates and effect sizes will be difficult in many circumstances where the perspectives of managers, auditors or stakeholders are contested or perceived to be arbitrary or vague. We advocate the use of confidence intervals as an alternative to power calculations. Confidence intervals offer an accessible approach to communicating performance under a standard and the extent to which a monitoring program is able to distinguish compliance from non-compliance. We illustrate these arguments and tools through a hypothetical example involving a proposed change in silviculture where the magnitude of gains in yield and environmental impacts are unclear.

Keywords: Forest management standards; Monitoring; Performance communication; Type I and Type II error; Statistical power; Confidence intervals

1. Introduction

Forestry standards seek to synthesize what is understood to be best practice. Examples include the Forest Stewardship Council International Standard (FSC, 2000), criteria and indicators developed under the Montreal Process (1999), and the Australian Forestry Standard (Standards Australia, 2003). Implicitly, accreditation under a standard asserts a company's commitment to best management and continuous improvement. The validity of this assertion rests on demonstrated compliance. This paper outlines how data gathered in monitoring can be analysed and communicated in a way that is accessible to managers, auditors and stakeholders. Its motivation is facilitation of evidence-based continuous improvement.

The criteria and indicators contained in a standard represent an attempt to encapsulate values associated with forests in a form that is amenable to measurement. Suter (1993) describes a hierarchical process for translating broad management goals into measurement endpoints. Management goals are statements that embody broad objectives. They are often ambiguous or vague, but carry with them a clear social or organizational mandate. Measurement endpoints are elements that can actually be measured. They can be regarded as operational definitions of management goals. In their emphasis on measurable outcomes as a means of demonstrating compliance, forestry standards inevitably tend toward reductionism at the expense of holistic ecosystem-level perspectives on forest processes. We regard the specification of measurable endpoints as a necessity in management systems where the insights from monitoring underpin adaptive management and continuous improvement.

The technical task of gathering and interpreting monitoring data within a continuous improvement framework takes place

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3. Decisions under uncertainty

Key question: How should a manager act in order to maximize learning and achieve long term management goals?

Example:

How should we design a conservation prioritization when habitat values are uncertainty?

Key concept: Robustness to uncertainty involves seeking strategies that are least likely to deliver unpleasant surprises: Robust satisfycing

Moilanen, A., B. A. Wintle, et al. 2006. Uncertainty analysis for large-scale reserve selection. Conservation Biology **20**:1688-1697.

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General principles

- Integrating ecological knowledge in defensible decisions
- Efficient allocation of conservation resources
- Making use of existing data and experts
- Dealing with uncertainty in decision making
- Learning and communicating by case study

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Activities

- Case studies, collaborations (agencies, other researchers)
- Working groups, meetings (agencies, other researchers)
- Transfer of individuals and expertise (uni-uni, uni-agency)
- Short courses (Marxan, WinBUGS, Monitoring design)
- Publications (books, journals, newsletters)

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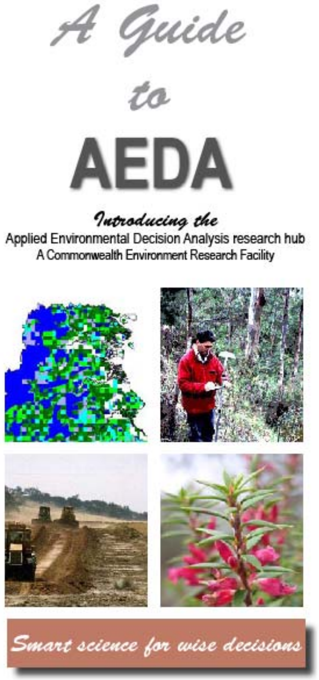
AEDA Communication

www.aeda.edu.au - fact sheets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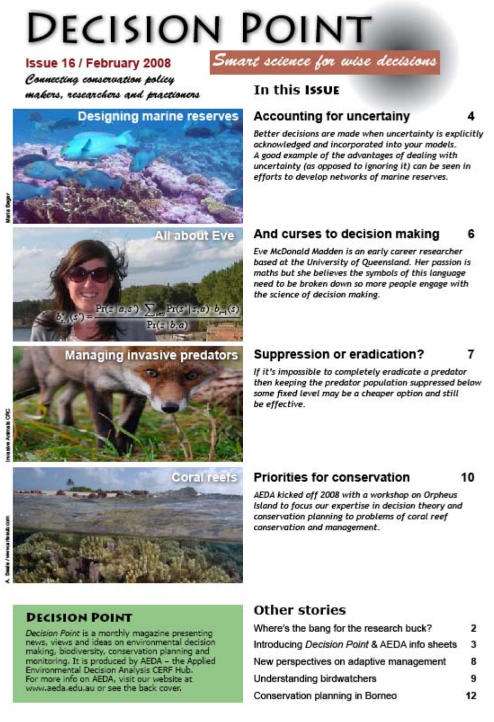
DECISION POINT

Issue 16 / February 2008

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Connecting conservation policy makers, researchers and practioners

In this ISSUE

Accounting for uncertainy 4

Better decisions are made when uncertainty is explicitly acknowledged and incorporated into your models. A good example of the advantages of dealing with uncertainty (as opposed to ignoring it) can be seen in efforts to develop networks of marine reserves.

And curses to decision making 6

Eve McDonald Madden is an early career researcher based at the University of Queensland. Her passion is maths but she believes the symbols of this language need to be broken down so more people engage with the science of decision making.

Suppression or eradication? 7

If it's impossible to completely eradicate a predator then keeping the predator population suppressed below some fixed level may be a cheaper option and still be effective.

Priorities for conservation 10

AEDA kicked off 2008 with a workshop on Orpheus Island to focus our expertise in decision theory and conservation planning to problems of coral reef conservation and management.

DECISION POINT

Decision Point is a monthly magazine presenting news, views and ideas on environmental decision making, biodiversity, conservation planning and monitoring. It is produced by AEDA – the Applied Environmental Decision Analysis CERF Hub.
For more info on AEDA, visit our website at www.aeda.edu.au or see the back cover.

Other stories

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Bureaucracy

- 1 Business, 1 PA
- Reporting obligations

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Plans for AEDA CERF

Expand the number of projects in SA and WA

Greater involvement of other researchers from outside the Hub

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Thanks.

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