

Five objections to prioritisation: Idiotic reasons not to use decision theory

I have given almost 200 seminars on using decision theory to solve environmental problems, during which I've heard a broad range of objections on its use. In this presentation I will review the most common objections and discuss their strengths and weaknesses.

Objection 1: "This is all ecological modelling and ecological models are all wrong."

Objection 2: The principles of decision theory are founded in economics and it is economics that has made a mess of the world. (i.e. decision theory is the tool of the devil.)

Objection 3: Using decision theory takes too long. While the general idea is good, we haven't got the time or money to use these approaches.

Objection 4: Nobody wants to have a computer tell them what to do. "Black-box" solutions to problems will never fly with politicians and stakeholders.

Objection 5: There is too much uncertainty and risk to use a decision theory approach.

It's important to dispel the myths surrounding these objections to the use of prioritisation. To ignore the value of environmental decision theory is to repeat the many mistakes that we have made in the last two decades. As a nation we're failing hopelessly to secure our most precious and unique natural asset – Australia's biodiversity. Since 1990, the Australian federal government has announced seven major natural resource programs collectively worth \$6.51 billion, and the skeptics have consistently pointed out that we have no quantifiable objectives, limited knowledge of what we have achieved and little idea about how investments were chosen.

Relevant publications

- Possingham HP (2001) *The Business of Biodiversity*. Australian Conservation Foundation TELA Series No. 9, 44 pp. <www.acfonline.org.au/uploads/res/res_tp009.pdf>.
- Joseph LN, Maloney RF and Possingham HP (2009) Optimal Allocation of Resources among Threatened Species: a Project Prioritization Protocol. *Conservation Biology*, DOI: 10.1111/j.1523-1739.2008.01124.x
- Hoegh-Guldberg O, Hughes L, McIntyre S, Lindenmayer DB, Parmesan C, Possingham HP and Thomas CD (2008) Assisted colonization and rapid climate change. *Science*, 321, 345-346.



Prof Hugh Possingham

h.possingham@uq.edu.au

University of Queensland

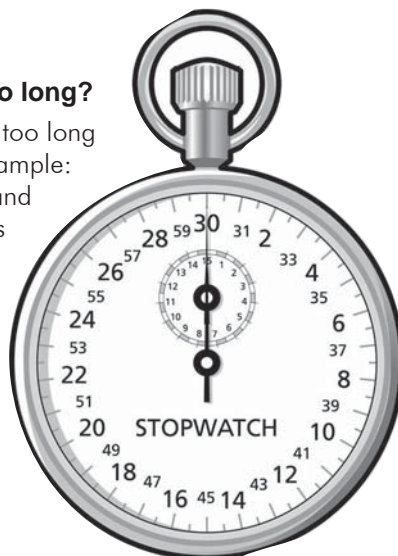
Day 1, 12.25pm

Area of work: ecological modelling and decision-making in the face of uncertainty

Area of specialty: Rational, repeatable and transparent approaches to environmental management that account for uncertainty, incomplete knowledge and scarce data. I'm particularly interested in optimal monitoring, adaptive management and robustness (ensuring acceptable outcomes in the face of uncertainty).

It takes too long?

Some claim that decision theory takes too long to achieve results. Consider this example: in conjunction with AEDA, the New Zealand Department of Conservation has developed the Project Prioritisation Protocol (Joseph *et al* 2009). In less than three years they have not only developed action plans for over 600 species, they have costed and prioritised them – all because the decision-making framework made recovery planning more focussed.



Take-home messages:

- Environmental values do not have to be turned into dollars and cents for them to be used in decision theory.
- Decision theory approaches and tools inform decisions rather than make decisions.
- Decision theory has many ways of rigorously accounting for uncertainty.

Five objections to using decision theory in conservation

And why they are wrong

By Hugh Possingham (Director, AEDA)

Since 1994 I have given almost 200 seminars on how decision theory can inform environmental management. In that time I've received a wide range of arguments about why decision theory tools should not be applied to conservation problems. Sometimes people reject the general message. Sometimes they take exception to the analysis of specific case studies. Sometimes they just get a little angry.

I'd like to take a moment and review the most common objections, and suggest that they are wrong. But I'm going to go further and say that NRM in Australia must embrace decision theory tools, like every other rational profession, from medicine to engineering.

It's important to dispel the myths surrounding these objections. To ignore the value of environmental decision theory is to repeat the many mistakes that we have made in the last two decades. As a nation we're failing hopelessly to secure our most precious and unique natural asset – Australia's biodiversity. Since 1990, the Australian federal government has announced seven major natural resource programs collectively worth \$6.51 billion (Hajkowicz, 2008). In almost every case the allocation decisions have been ad hoc. The states and the regional bodies have not performed any better.

So, here are the five most common objections with their strengths and weaknesses.

Objection 1: "This is all ecological modelling and ecological models are all wrong."

Well, of course, this is correct; all models of everything are wrong. The only perfect model for something is the thing itself, and then it ceases to be a model. However models are our only way of predicting the future and if you are a manager you must be predicting the future as a consequence of actions – otherwise you could never take an action. Hence, by definition, every manager is a modeller – it is just that most don't use maths.



Furthermore there is confusion between what is a model, what is a problem and what is an algorithm. Much of decision theory is about mathematically defining a problem with objectives and constraints, which is not classical ecological modelling. This is the translation of human hopes, dreams and fears into maths, another language.

It is not classical ecological modelling. Often there are some more standard ecological models that lie inside the problem definition, and they should be scrutinised with care. Finally we use algorithms, not models, to find good solutions to the problem (not the model). If one uses mathematically credible algorithms (not scoring systems or overlays of GIS maps) then the solutions are likely to be close to correct. (See *Decision Point* #22, p2, for a more detailed discussion on this point.)

“Environmental values do not have to be turned into dollars and cents for them to be used in decision theory.”

Objection 2: The principles of decision theory are founded in economics and it is economics that has made a mess of the world. Decision theory is the tool of the devil.

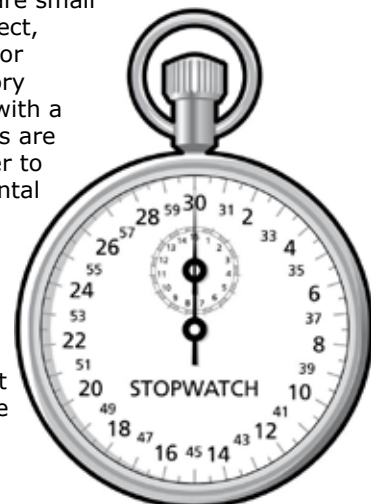
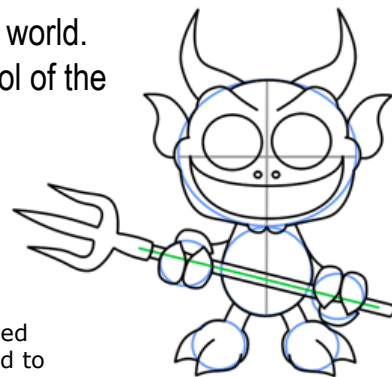
You can kill someone with a hammer but it doesn't mean that hammers are bad tools. The tools we use are largely from a branch of mathematics called operations research, designed to solve mathematically well-defined problems. These tools are used by engineers, mathematicians and economists (who are no more than mathematicians who know some big complex words). Decision theory tools drive most small scale (micro-economic) decisions from how to supply troops in a battle to oil refineries ordering crude supplies to airline companies devising their plane schedules.

One aspect of decision theory that does irk people (and is very much an economic way of thinking) is that we generally need to give every value a quantity. Typically economists deal mainly with money, but environmental values often deal with things that at first glance seem harder to quantify – threatened species, ecosystem services and social values. However, with thought, most can be quantified, albeit with some uncertainty (see objection 5) and they do not have to be turned into dollars and cents for them to be used in decision theory. One algorithm that provides good solutions to many conservation problems involves ranking actions in terms of their effectiveness, which is benefit over cost – that is their biodiversity benefit divided by their dollar cost. This simply requires an integrated and numerical measure of the biodiversity benefits of an action.

Objection 3: Using decision theory takes too long. While the general idea is good, we haven't got the time or money to use these approaches.

In cases where decisions are small and once-off, you are correct, spending money on using or developing a decision theory tool is like cracking a nut with a steam roller. However tools are becoming easier and easier to use, and many environmental management problems involve millions of dollars. In most cases the use of an approach or tool will save money and biodiversity. Or, more uncharitably, if you are not using the most appropriate decision theory tools you

*The Dpoint
editorial*



Five objections

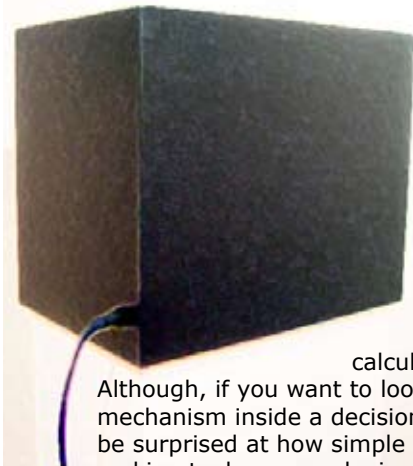
(Continued from p2)

may well be consigning some biodiversity to extinction!

Decision theory tools might slow some projects, down, but in some cases the focus provided by formulating and solving an explicit problem speeds things up. For example consider the project prioritisation protocol that the New Zealand Department of Conservation have developed and used in partnership with AEDA (Joseph et al, in press). In less than three years they have not only developed action plans for over 600 species, they have costed and prioritised them – all because the decision-making framework made planning more focussed. Australian agencies have been developing recovery plans for two decades at huge expense: many remain unfinished or incomplete.

Objection 4: Nobody wants to have a computer tell them what to do. “Black-box” solutions to problems will never fly with politicians and stake-holders.

You are correct, which is why we always say that these approaches and tools inform decisions rather than make decisions. There are invariably considerations that cannot be accommodated in the formulation of an environmental problem – so we need some wiggle room.



As far as black-boxes are concerned – so what? What percentage of the public know how planes fly, or hand calculators calculate, or microwaves cook?

Although, if you want to look a bit more closely at the mechanism inside a decision-tool black box, you might be surprised at how simple they are. Many decision-making tools are much simpler than people think if they are explained well and people take some time to work with them.

Objection 5: There is too much uncertainty and risk to use a decision theory approach. Furthermore, optimisation is not robust.

Uncertainty and risk are rife in ecological systems – and we face it far more than, say, an engineer (but no more than economists or doctors). Fortunately the mathematicians have many ways of rigorously accounting for uncertainty in decision-making – indeed if a system has a lot of randomness then it is even more important to take a formal quantitative decision-making approach. Some people think that decision theory tools can only deliver perfect but fragile solutions – however there are many algorithms for obtaining robust solutions, solutions that deliver reasonable results under a lot of randomness and uncertainty.



“If you are not using the most appropriate decision theory tools you may well be consigning some biodiversity to extinction.”

So there are my five objections to prioritisation (they are really classes or streams of objections rather than specific snipes), and I'd describe them all as myths that the nation can no longer afford to accept. After peddling the decision-theory message for 15 years, I think the message is unanimous and unambiguous – it is now the responsibility of managers and policy-makers to make use of the best available science and tools.

This editorial mirrors the presentation I'll be making at the Fenner Conference on the Environment in March. The conference, being run with our sister CERF Hub Landscape Logic, is all about the art and science of good environmental decision making. Australia leads the world in research in environmental decision theory. It's a rapidly developing field, but thanks to initiatives like the CERF program I believe we now have the science to address the weaknesses that have plagued our NRM investments up until now.

References

- Hajkowicz SA (2008) The Evolution of Australia's Natural Resource Management Programs: Towards improved targeting and evaluation of investments. *Land Use Policy*. doi:10.1016/j.landusepol.2008.06.004
- Joseph LN, Maloney RF & Possingham HP (in press) Optimal Allocation of Resources among Threatened Species: a Project Prioritization Protocol. *Conservation Biology*, DOI: 10.1111/j.1523-1739.2008.01124.x (available from l.joseph@uq.edu.au on request)

Five (invalid) objections

Objection 1

Ecological models never capture everything

Objection 2

Decision theory is economics rebadged

Objection 3

Decision theory takes too long

Objection 4

'Black-box' solutions aren't acceptable

Objection 5

There is too much uncertainty and risk