

DECISION POINT

Connecting conservation policy
makers, researchers and practitioners

Issue #67 / March 2013

No space to land!

The plight of the migratory shorebird



**Robust decisions about
willows in the high country**



**Walking with leeches
a summer camp with edge**



**The value of information in
planning for sea level rise**

Decision Point

Decision Point is the monthly magazine of the Environmental Decisions Group (EDG). It presents news and views on environmental decision making, biodiversity, conservation planning and monitoring. See the back cover for more info on the EDG. *Decision Point* is available free from <http://www.decision-point.com.au/>

Plus

Developing species distribution models
The value of information for koala conservation
The importance of accounting for uncertainty
Connecting science and management at
Booderee National Park

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Our cover: Migratory shorebird numbers are plummeting as east Asian stopover sites are lost to development. See page 4. Photo by Rob Clemens.

On the point

The value of information

How much should you spend on getting more information before making a decision? It's an important question because spending money on acquiring more information means you probably have less to spend on managing the thing that you're interested in. And, it could be that the additional information doesn't actually result in a better outcome.

Understanding the true value of information is a critical element of good environmental decision making, and it's the theme of many of the stories in this issue of Decision Point.

If you're planning coastal nature reserves that aim to preserve habitat for biodiversity in 2100, how much of your limited resources would you invest in acquiring high quality information? Maybe low quality information (that's significantly cheaper) is just as good and the money you save could go towards acquiring more land for the reserve. This is the question Rebecca Runting and Jonathan Rhodes ask on page 10 and the answer is quite surprising.

If you're managing threats to koalas, how much time and money do you spend acquiring more info on koala birth and death rates? Sean Maxwell asks this question on page 9. In so doing he explains why 'value of information' analysis is a standard tool in the mining industry. Maybe conservation managers should do the same.

Willows are infesting Victoria's alpine bogs and managers have to make some very important decisions on what to do about it. Joslin Moore explains on page 6 how a structured decision making approach helped them deal with the enormous uncertainty around this problem and arrive at a robust decision. Joslin also undertook a value of information analysis to help them decide whether they should invest in improving their knowledge about this issue. Managers were surprised by the answer: on existing budgets there's little point in learning more, they should simply get on with the job. 🍌

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DECISION POINT

Decision Point is the monthly magazine of the Environmental Decision Group (EDG). The EDG is a network of conservation researchers working on the science of effective decision making to better conserve biodiversity. Our members are largely based at the University of Queensland, the Australian National University, the University of Melbourne, the University of Western Australia, RMIT and CSIRO.

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Short accounts of papers (old and new) from EDG researchers. If you would like copies of any of these papers please visit:

<http://decision-point.com.au/research-briefs.html>

Connecting science & management (at Booderee)

Management of national parks is mainly based on the experience of resource managers and not directly on new scientific knowledge and evidence. And yet there are many advantages to connecting management with research on the ground. This paper demonstrates this value by describing the development of a strong and enduring partnership between scientific research and resource management in Booderee National Park (BNP), a coastal reserve next to Jervis Bay on the south coast of NSW. The partnership has focussed on three key issues within Booderee: the impacts of fire on native biota, the response of vertebrates to feral animal control and the control of Bitou bush.

In regards to fire, a new understanding of the relationships between bird persistence and recovery following fire (derived from empirical research) has resulted in a change from uniform prescribed burning of entire compartments of native vegetation to patchy fires across a maximum proportion of a given compartment.

Research has demonstrated the value of feral animal control showing it substantially increases populations of some animals such as the common brushtail possum, the long-nosed bandicoot and the eastern bristlebird. On this basis, an intensified approach to feral animal control in BNP is now well established as a key and ongoing conservation activity recognised formally within the official management plan for the reserve.

And research on different forms of Bitou-bush control show that the current approach to control at BNP appears to be effective. However, it is important to limit the number of fires that occur in areas subject to Bitou-bush control so as to avoid damage to native ecosystems.

The authors describe what has enabled this successful science/management partnership. Factors believed to be important include co-location of staff, continuity of staff, provision of adequate funding for science and the shared identification of knowledge gaps. 🍓

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Reference

Lindenmayer DB, C MacGregor, N Dexter, M Fortescue & P Cochrane (2013). Booderee National Park Management: Connecting science and management. *Ecological Management & Restoration* 14: 2–10. doi:10.1111/emr.12027
<http://onlinelibrary.wiley.com/doi/10.1111/emr.12027/full>



Booderee National Park ranger Nick Dexter (foreground) discusses Bitou bush control with scientists and managers during a science workshop in the park. The science/management relationship that has been cultivated at Booderee has made an important contribution to conservation outcomes in the coastal reserve.

The importance of accounting for uncertainty

The importance of accounting for economic costs when making environmental-management decisions has been increasingly recognized in recent years (and the EDG has played an important role here). Uncertainty associated with such costs, however, has often been ignored. We developed a method, on the basis of economic theory, that accounts for the uncertainty in population-management decisions. Instead of maximizing the expected outcome, we maximized the probability of obtaining an outcome above a threshold of acceptability.

To illustrate our approach we revisited a previous study that incorporated cost efficiency analyses in management decisions that were based on perturbation analyses of matrix population models. Incorporating derivations from this study into our framework, we extended the model to address potential uncertainties. We then applied these results to two case studies: management of a Koala population and conservation of an olive ridley sea turtle population. For low aspirations, that is, when the threshold of acceptability is relatively low, the optimal strategy was obtained by diversifying the allocation of funds. Conversely, for high aspirations, the budget was directed toward management actions with the highest potential effect on the population.

Our analysis demonstrates that the exact optimal allocation was sensitive to the choice of uncertainty model. Our results highlight the importance of accounting for uncertainty when making decisions and suggest that more effort should be placed on understanding the distributional characteristics of such uncertainty. 🍓

Reference

Salomon Y, MA McCarthy, P Taylor & BA Wintle (2012). Incorporating Uncertainty of Management Costs in Sensitivity Analyses of Matrix Population Models. *Conservation Biology* 27: 134–144.

The influence of landscape structure on foxes & cats

Foxes and feral cats (and invasive mammalian predators in general) are often associated with fragmented landscapes. Their presence can compound the impacts of habitat loss and fragmentation on native fauna. Knowledge of how invasive predators are influenced by different landscape structures can assist in mitigating their impacts.

Cameron Graham and colleagues investigated the variation of the frequency of red-fox and feral-cat detections among landscapes and habitat patches of varying complexity. The study was conducted in brigalow-dominated landscapes in south eastern Queensland. They looked at large remnant patch interiors, large remnant patch edges, small remnant patches, roadside verges, regrowth patches and open agricultural land adjacent to a remnant patches.

They found that their detection rates increased in more complex landscapes and habitats, and concluded that spatially heterogeneous cropping landscapes incur higher rates of invasive-predator detections than do intact native-woodland and pasture landscapes at the 1-km scale. At a site scale, elevated invasive-predator detections occurred at sites with dense vegetation, characteristic of narrow woodland and the edges of large woodland patches.

The research findings highlight that vertebrate pest management needs to target highly fragmented agricultural landscapes that are more likely to have elevated levels of invasive-predator activity. Landscape restoration efforts need to consider the redesign of landscapes to make them less suitable for predators and more hospitable for native wildlife. 🍓

Reference

Graham CA, M Maron & CA McAlpine (2013). Influence of landscape structure on invasive predators: feral cats and red foxes in the brigalow landscapes, Queensland, Australia. *Wildlife Research* 39: 2012: 661-676.

Migratory birds, citizen science and scientific certainty (& uncertainty)

How certain do we need to be before we do something?

By Robert Clemens (EDG, University of Queensland)

Multiple lines of evidence are telling us that many species of migratory bird are in crisis. It's a global problem crossing multiple national borders and there are no easy solutions. It's also a problem which needs to be addressed quickly yet our political leaders have largely consigned it to the too-hard basket. One of the reasons for this is a desire for scientific certainty before action is taken.

Demanding certainty

The profile of science has risen dramatically in policy making in recent years. Whether it's climate change mitigation, the Murray Darling Basin Plan or the appropriateness of super-trawlers fishing our territorial waters, all are talked about in terms of whether the science is certain. But what happens when government demands certainty in the science before acting, but won't fund the studies to provide that certainty? And when it comes to endangered species, not acting can lead to irreversible loss.

Migratory shorebirds are a point in case. Many groups of migratory shorebird appear to be showing widespread decline. Recent research on migratory birds and shorebirds in Japan and around Australia indicate that some species appear to have declined by anywhere from 30% to 80% in the past 15 to 30 years.

When faced with potential biodiversity losses such as those in shorebirds, decision makers often require high levels of certainty regarding any negative impacts of human activity on ecosystems before doing anything. They are unlikely to support the typically costly actions to avoid impacts until they have strong evidence (even though this flies in the face of the Precautionary Principle, see box).

Unfortunately, such evidence can be difficult and expensive to deliver. Resources are scarce, and there has been under-investment in data collection for the past several decades. The unfolding evidence of large



No space to land. A flock of bar-tailed godwits arrive in Australia. Unfortunately shorebirds such as these are losing critical habitats at other places along their migratory routes and have experienced worrying declines in recent years. (Photo by Rob Clemens)

We need to act now

The reclamation of inter-tidal habitats in the Yellow Sea needs to stop, and it needs to stop now. And that's especially the case in those areas used by large numbers of migratory shorebirds. China's coast in the Bohai Sea is a place where this need is perhaps most immediate. The evidence for this need has been developed by members of the Australasian Wader Study Group, Birds Korea, the Saemangeum Shorebird Monitoring Programme and, most recently, from work being led by researchers from Richard Fuller's lab at the University of Queensland. Evidence of declines in the migratory shorebirds that visit Australia has been growing for over a decade, including recent work highlighting the declines of migratory shorebirds in Moreton Bay (Wilson et al. 2011). Evidence of the loss of inter-tidal habitats throughout the coasts of the Yellow Sea has also been growing with a recent paper highlighting a method for quantifying the extent of large areas of intertidal habitat (Murray et al. 2012). A recent motion at the World Conservation Congress regarding the conservation of intertidal habitats reflects a growing understanding of the plight of migratory shorebirds and the large losses of intertidal habitats in the Yellow Sea. It is important that governments act now based on the best available evidence to conserve intertidal habitats in the Yellow Sea, and that the lack of certainty around some parts of the shorebird story not be used as an excuse for inaction.

Wilson HB, BE Kendall, RA Fuller, DA Milton & HP Possingham (2011). Analyzing Variability and the Rate of Decline of Migratory Shorebirds in Moreton Bay, Australia. *Conservation Biology* 25: 758-766.

Murray NJ, SR Phinn, RS Clemens, CM Roelfsema & RA Fuller (2012). Continental Scale Mapping of Tidal Flats across East Asia Using the Landsat Archive. *Remote Sensing* 4: 3417-3426.

declines in migratory shorebirds exemplifies a rare long-term data set collected by volunteers that shows just how much information is needed to deliver strong evidence.

Remarkable journeys

Many shorebirds make remarkable journeys around the planet, at times coming together in clouds of birds that defy human comprehension. And it's not just one or two closely related species that make these journeys. Migratory shorebirds that visit the coasts and wetlands of Australia are very diverse. They come from breeding areas in the Arctic tundra, the steppes of central Asia, or large meadows found within boreal forests.

Many of the young are able to find their own food only days after hatching in the far north, and a few weeks later, most fly south independently with no help from their parents or other experienced guides.

Most fatten up before they leave, in some cases to over 80% above their typical weight. They put on up to 5% weight gain per day in just a couple of weeks. These birds depart on their migrations looking like over-inflated footballs with wings, and yet some are known to fly up to 12,000 km for over eight days non-stop across the Pacific.

“It is important that governments act now based on the best available evidence, and that the lack of certainty around some parts of the shorebird story not be used as an excuse for inaction.”

Bogged down in the willows

Making robust conservation decisions in the face of uncertainty

By Joslin Moore (Australian Research Centre for Urban Ecology, University of Melbourne)

How much should we invest in learning as opposed to doing when it comes to conservation management? Keep in mind that investing in learning is taking resources away from the management itself, and may even lead to delays in getting on with the job. Of course, if you have a good idea of the nature of the problem you're managing and the benefits of learning then it's relatively easy to weigh up your options. However, if there's substantial uncertainty around the issue, as there is with most conservation problems, then it's a different story.

A common response to this vexed issue of learning versus doing in the face of great uncertainty is simply to ignore the issue – we make the best decision that we can based on what we know (or don't know) and trust our intuition. Unfortunately, intuition is usually a poor guide in dealing with complex conservation issues in the face of high uncertainty.

A better way is to apply a framework of structured decision making together with a value-of-information analysis to identify robust management strategies. How does this work? Consider how we applied this approach to develop a long-term management strategy for the invasive gray sallow willow up on the Bogong High Plains (Moore & Runge, 2012). The stakes are high (see the box on 'the curse of the gray sallow willow') with the prospect of this very invasive willow taking over an endangered alpine ecosystem. There is great uncertainty surrounding the available options and, looking into the future, this is compounded by a changing climate and shifting fire regimes.

Structured decision making involves working with key stakeholders involved in a problem to create an agreed framework around the decisions they need to make. The process we use comprises seven steps (outlined in figure 1). It involves setting a context, agreeing on objectives, listing the various available options to meet these objectives and devising ways to compare the costs and benefits of those options.



The fundamental objective: saving the alpine bogs in Pretty Valley on the Bogong High Plains. (Photo by Joslin Moore)

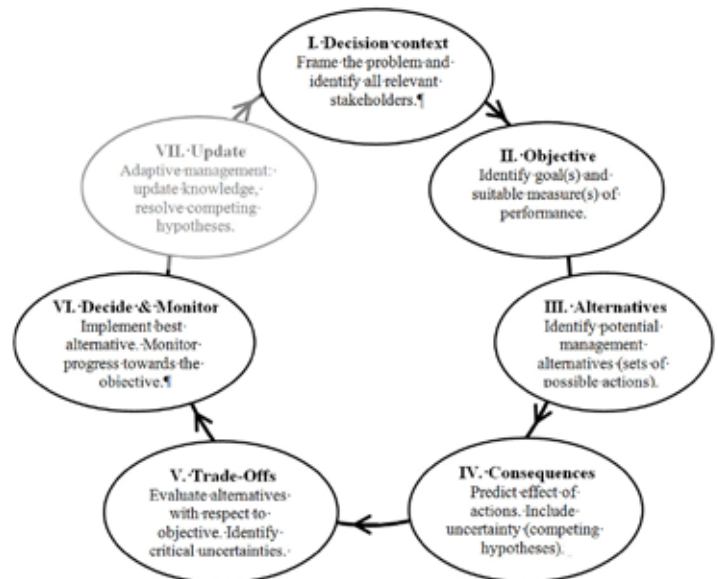


Figure 1: Key steps in a structured decision making process.

Using the information gathered in steps I-III, we built a dynamic model that described the system and the effect of different management actions (step IV) and included a feedback loop to ensure the management agency was satisfied that the model accurately described the problem they had defined. We used the model to identify the best management actions taking uncertainty into account (Step V), reported the results of our analyses to the management agency and they subsequently made a decision (Step VI). Steps I-III and step VI are values-based steps determined by the decision makers. Step IV and V (and VII-if required) are science-based decision analysis steps.

This framework also can be used for adaptive management if the decision is recurrent and the structured-decision process identifies critical uncertainties that, if resolved, have the potential to improve the management decision. If such uncertainties are identified, a plan for learning can be developed as part of step V, incorporated in the monitoring regime (step VI), and used to update knowledge and repeat the analysis (step VII).

Supporting decisions around willow management

To go through this process with the willows problem we ran a three-day structured decision making workshop. It emerged during this time that the major decision faced by the willow managers was where to focus their control effort. The removal of willows from EPBC listed alpine bogs was identified as the main objective of management so the control of willows in bogs seemed a good place to start.

However, willow establishment is facilitated by wildfires which are predicted to increase with climate change. Should some effort be

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Contractors get stuck into controlling a willow on the Bogong High Plains. (Photo by Joslin Moore).

Gray willow on the high plain

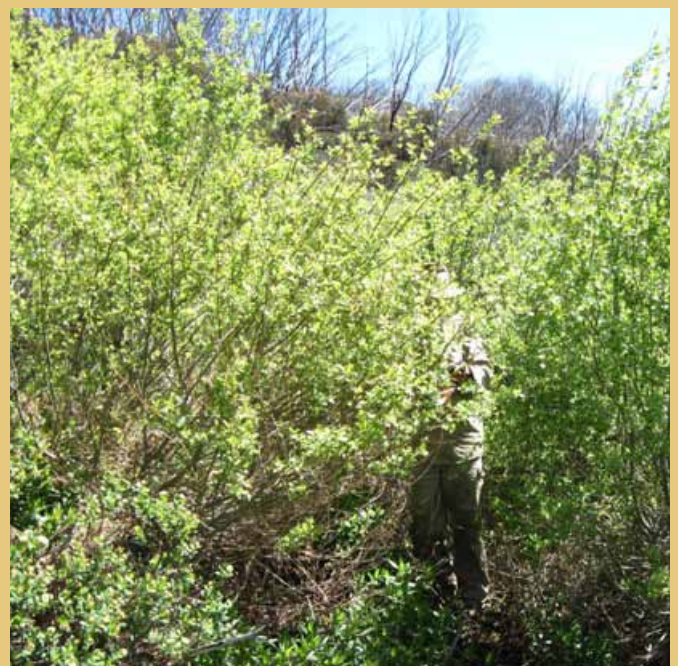
In 2003, a severe wildfire burned out half of the Bogong High Plains, Australia's largest contiguous area of alpine and subalpine vegetation. The event was followed by the widespread establishment of seedlings of the gray willow (*Salix cinerea*), a multi-stemmed invasive shrub native to Europe.

That spells big trouble for the Plains. The gray willow is one of the few willow species able to produce seed in Australia. It can inhabit a wider variety of environments than other introduced willows and is the only *Salix* known to have colonized Australia's alpine regions. The species reproduces predominantly by seed but does not form a persistent seed bank. Seeds are wind dispersed and can disperse tens of kilometres, and the species is also able to regenerate after fire.

The big fear is that willows will destroy the precious bogs found in the Bogong High Plains. The bogs are listed as endangered under the EPBC Act and invading willows compromise them by reducing available water (these willows use large amounts of water compared with native species), displacing native vegetation, and disruption of aquatic nutrient cycles. Parks Victoria, the agency responsible for management of the Bogong High Plains, considers the invasion by gray willow as one of the main threats to persistence of the bogs.

So what's to be done given limited resources and enormous uncertainty about how the threat will develop? Parks Victoria wished to identify a practical and effective long-term strategy to eradicate (or minimize) willows in bogs on the Bogong High Plains. The key decision to be made was the proportion of resources to allocate to the management of existing populations of willow in bogs and to source populations of willow that may serve as sources of colonists in the future.

There is also substantial uncertainty regarding the demographics of gray willow populations and the source of the current invasion. Given this uncertainty, the management agency wished to decide where to focus control effort and whether the management strategy could be improved through learning.



A Parks Victoria employee struggling to see the bog for the willows. (Photo by Carmen de Rooze)

allocated to removing mature seed-producing willows in nearby waterways to prevent invasions in the future? If so, how much effort? In the absence of a strategy, managers had been allocating effort to bogs and waterways guided by a combination of intuition and available resources.

We used structured decision making to formally describe this decision (figure 1). We built a stochastic model of the spread of willow onto the Bogong High Plains and used it to calculate how different management strategies would affect the amount of willow in bogs over the next 200 years. The model contained approximately 40 factors or parameters, most had never been measured and were highly uncertain. We incorporated this uncertainty into the model by choosing parameters from probability distributions (that represented our uncertainty about the parameter values) and re-running the model 10,000 times.

Optimal management

Using the model, we identified where control effort should be focused to minimise the abundance of willows in bogs over the

Continued on page 8

Bogged down in the willows

Continued from page 7

longer term. This was done by calculating which management alternative worked best on average across the 10,000 possible scenarios.

The optimal strategy was to allocate all available effort to the bogs until the budget exceeded 2,000 work days per year. It needs to be noted that 2,000 work days per year is four times the current budget levels. Beyond this point it was optimal to allocate some effort (20-60% total budget) to eliminate populations of seed-producing willows in nearby rivers. Effort was allocated to the closest populations first and then to more distant waterways as the budget increased.

We also identified which parameters had the biggest influence on the spread of willows (using sensitivity analysis). The analysis showed that the most important factors in determining the spread of willow was the frequency of fires, the mean dispersal distance of willow seeds and the rate that bog vegetation recovered after fire.

Should we invest in improving our knowledge?

Finally, we calculated the value-of-perfect-information. The value-of-perfect-information is a deceptively simple calculation that enables us to identify how much we could improve our management decision if we had perfect knowledge prior to making it (in this case if we actually knew what the parameter values were in the model before we made our decision). It measures the maximum amount that we could expect to improve the outcome if we could resolve all the uncertainty.

The results of the value-of-information analysis were quite surprising for managers. It revealed that learning more about the system is unlikely to improve the ability to manage willows unless current budgets are substantially increased. The increase in performance if information is perfect is negligible for small to medium budgets because the same strategy (only treat willows in bogs) is optimal for the majority of the 10,000 scenarios. When budgets are large, the best location to control willows depends on the specific scenario (parameter values) although the improvement was modest (~10%). In these cases, learning about willow seed dispersal distance was the most important.

Although the most effective management strategy was clear, there was substantial uncertainty about the effectiveness of the strategy even when the best management action was taken. Sometimes, there were scenarios when any of the proposed management interventions would fail. This uncertainty makes it difficult to justify budget allocations to willow management when there are competing demands for resources. Improving understanding of fire frequency, bog recovery rates, and dispersal from source populations would contribute most to informing decisions about budget allocation to willow.

Did the process help?

Taken together the key conclusions of the workshop and analysis were that the objective of management was to protect endangered bogs from willow invasion. The best way to achieve this (given current budgets) was to focus exclusively on controlling willows within bogs although there was substantial uncertainty regarding how successful management would be.

Unless budgets increased substantially, investing in research or adaptive management to learn about the system and resolve key uncertainties (fire frequency, willow seed dispersal distance, bog vegetation recovery rate) would not improve our ability to

manage the system. If budgets did increase substantially, learning about willow seed dispersal distance would contribute the most to improving management.

While these conclusions may seem obvious in retrospect they were not obvious to managers prior to the workshop. Less than 50% of control effort was focused on bogs when the willow control program was first instigated.

Despite enthusiasm from managers, it has taken approximately 18 months for the results to be fully integrated into the management process. Although managers started to allocate increased effort in bogs in the 6 months following dissemination of the workshop results, it was not until the second control season that all control effort was allocated to bogs.

Structured decision making and value-of-information analysis can be applied to any problem where a decision needs to be made. Together they provide a relatively simple way to make a decision in the face of uncertainty and evaluate the need for learning.

Of course, it helps if you have a decision scientist assisting you in building the models and running the analysis. So, if you have a tough and important decision coming up, see if you can interest a decision analyst in your problem today! 🍷

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Joslin is currently based at the Royal Botanic Gardens Melbourne working with the Australian Research Centre for Urban Ecology and the School of Botany at the University of Melbourne. The research described here was done as part of AEDA, the precursor to the NERP ED.

Reference

Moore JL & MC Runge (2012). Combining Structured Decision Making and Value-of-Information Analyses to Identify Robust Management Strategies. *Conservation Biology* 2: 810–820.

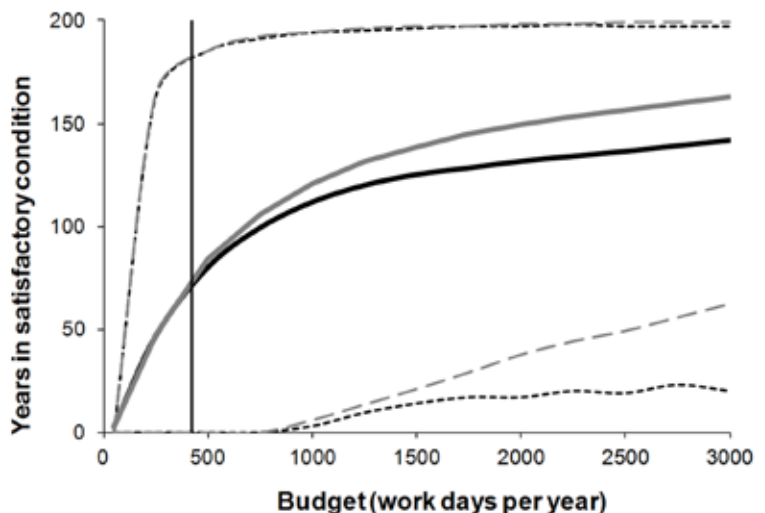


Figure 2: The expected performance of optimal management strategy with and without perfect information.

The solid black line represents expected performance of the optimal strategy in controlling willow given current knowledge (dashed black lines are 90% quantiles). Solid grey line indicates expected performance of the optimal strategy in controlling willow if parameter values are known prior to allocating effort (indicates how much performance could be improved if information was perfect (dashed grey lines are 90% quantiles for perfect information). And the vertical line shows resources allocated to control of willow in 2008-2009.

The value of more information

Thinking like a multi-billion dollar mining magnate may help to preserve biodiversity

By Sean Maxwell (EDG, University of Queensland)

Koalas in south-east Queensland are in trouble. They are threatened by vehicles, dog attacks and disease (see 'Managing threats to koalas'). And these threats are growing as koala habitat is cleared to make way for new housing and industrial estates. The rate of decline is alarming, with the population crashing from an estimated 6000 individuals to fewer than 2000 in the space of 15 years. In response to appeals from koala managers, conservation scientists and the public to do something, the Queensland Government has allocated \$26.5 million to managing koalas in south-east Queensland over the next four years. How should we spend this \$26.5 million to maximise the chance of koalas persisting in South-East Queensland?

Most natural resource management budgets are typically allocated to either gaining new information about the species (or ecosystem) in question or to direct management action. In the case of the koala, there is uncertainty about the birth and death rates, and the effect of forest cover on these rates. Gaining new information that would reduce these uncertainties may lead to more effective management strategies. Alternatively, new information about these uncertainties may not change how we are currently managing the species, and a better investment could be to allocate funds to direct management action now.

These kinds of resource allocation problems are not restricted to natural resource management. They are common in health, economics, business management and the mining sector. Decision-makers in these fields have turned to analytical tools to help make good resource allocation decisions in the face of uncertainty. For example, imagine that you are Gina Rinehart and that you're reviewing a proposal for a potentially lucrative coal mining project. The project could bring in big returns, but the mining sector is competitive, and you don't want to blow millions on a project that isn't viable.

If you were in this position, the question you would ask yourself is: "should I fund geological studies, exploratory drilling and price forecasts to reduce my level of uncertainty about the site, and hopefully improve the long-term success of the proposed mining project?"

Instead of relying on gut feelings or expert opinion to answer this question, the smart approach is to use Value-of-Information analysis to help make this decision. It presents a way of evaluating the benefits of collecting additional information before making a decision. If after conducting the Value-of-Information analysis you see that the expected improvement in your profit margin from having additional information is not worth the cost of obtaining that information, then there's little point in making that investment.

Where a miner might think in terms of profit, environmental decision makers think in terms of conservation outcomes. Given limited funds to address the enormous challenge of arresting the decline in koala numbers, should we invest in learning more or just get on with the job?

Over the past year, I have been working with EDG researchers Eve McDonald-Madden, Jonathan Rhodes and Hugh Possingham in applying Value-of-Information analysis to evaluate the benefits of resolving uncertainty surrounding the declining koala population in South-East Queensland. We modelled the effectiveness of koala management using current levels of information and compared this to a situation where all uncertainty about birth and death rates, and the effect of forest cover on these rates, was resolved.

“If resolving uncertainty costs more than 1.7% of the koala management budget, it would be more cost-effective to allocate that money to direct management action now.”

We found the optimal management strategies with and without new information on birth and death rates, and the effect of forest cover on these rates, to be very similar. This similarity suggests that resolving uncertainty will have negligible effects on management performance. Indeed, we found that a 0.034% improvement in the population growth rate is the best we could expect if uncertainty was resolved. When we converted values of information, in terms of population growth rate, into values of information in terms of dollars, we found that if resolving uncertainty costs more than 1.7% of the koala management budget, it would be more cost-effective to allocate that money to direct management action now.

In the coming months, we intend to explore the value of resolving other sources of uncertainty surrounding the management of koalas in South-East Queensland. This future research may place more value on gaining new information, but the results of our analysis to date suggest that allocating resources to direct management action now will likely provide better returns on investment than gaining new information.

The low values of information illustrated in our koala case study have also been mirrored in case studies using other focal species. However, cases exist where gaining additional information has dramatically improved management performance. These contrasting results from different Value-of-Information analyses show how uncertainty can have variable effects on our ability to achieve a management objective. They highlight the benefits and importance of a Value-of-Information analysis before making that all important investment decision. 📌

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Managing threats to koalas

Why did the koala cross the road? Because it didn't have any choice. Previous EDG research has showed that, as forest cover is lost, total koala mortality and the proportion of that mortality arising from vehicle collisions is increasing. Using integrated population modelling to understand the implications of multiple threats to koalas in South-East Queensland, the research highlighted that management needed to address the multiple threats of habitat loss, disease, vehicle collisions, dog attacks and climate change together. Restoring habitat on its own would be insufficient to prevent further declines.

(Image by Liana Joseph)

More info

Rhodes JR, CF Ng, DL de Villiers, HJ Preece, CA McAlpine & HP Possingham (2011). Using integrated population modelling to quantify the implications of multiple threatening processes for a rapidly declining population. *Biological Conservation* 144: 1081–1088.

Or read *Decision Point* #50 (p6,7)

Beyond the bathtub

The value of information for conservation planning under sea level rise

By Rebecca Runting & Jonathan Rhodes (EDG, University of Queensland)

If you were given the task of locating a reserve system to preserve coastal biodiversity, how much of your limited budget would you devote to acquiring high-quality data? Of course, collecting and using high-quality data is more expensive than using rougher, low-quality data. And the money you save in this step, which might be considerable, could be put towards acquiring more land so it's far from being an academic question.

It is not necessarily true that gathering more or better quality information leads to better conservation outcomes, especially when resources must be split between the collection of information and the implementation of management actions. Understanding the trade-offs between investing in more information versus implementing conservation actions is therefore an important issue.

And it's especially important in a world experiencing a rapidly changing climate. Under these conditions, the distribution of biodiversity may be highly dynamic. This is particularly true for coastal systems, where sea-level rise presents considerable challenges for developing cost-effective plans to preserve biodiversity. For instance, sea-level rise is likely to inundate and displace wetlands and other low-lying ecosystems. This may lead to the loss of breeding grounds for many marine animals, along with increased coastal flooding and erosion and saltwater intrusion into estuaries, deltas, and aquifers.

Sea-level rise doesn't necessarily mean the death of a wetland. Coastal wetlands may adapt to rising levels by migrating landward, or increasing their vertical elevation if there is sufficient sediment build up. However, to accommodate this landward migration, it may be critical to set aside areas that are free of physical barriers that might impede the retreat of these ecosystems.

So, what's the value of higher quality data for conservation planning relating to sea level rise? We explored this issue by determining the cost-effectiveness of investing in high-resolution elevation data and process-based models for predicting wetland shifts in a section of Moreton Bay in South East Queensland.

Different models, different data

Coastal impact models are a useful tool for projecting the environmental responses to sea level rise and can inform plans for adaptation. We examined two different impact models with two different datasets for elevation to predict the consequences of lower, mid-range, and upper sea level rise projections to 2100.

The first impact model is a simple inundation model. It works by simply projecting sea level rise onto a topographic map, and any area below the given contour is identified as being inundated. These models are sometimes referred to as bathtub inundation models and simply plot what land disappears as levels rise. They're relatively quick and easy to use, can function with fairly basic data inputs but are somewhat simplistic in their projections. They don't take in to account, for example, sediment build-up and other key processes that remodel the landscape as sea level gradually rises.

The other model we used is called SLAMM, which stands for the Sea Level Affecting Marshes Model (see www.warrenpinnacle.com). It's a

“For the upper sea-level rise scenario it was worth spending up to 99% of the budget on acquiring the high quality data.”



Mangroves on Stradbroke Island, Queensland. Accurately modelling how sea-level rise will change these landscapes could be critical to saving them. (Photo by Catherine Lovelock)

more sophisticated software package that gives modellers the ability to account for many of the processes that get left out of the simpler bathtub model. For example, it can incorporate accretion, erosion and wetland shifts following changes in saline water conditions. It also accounts for subsidence, isostatic adjustment, existing seawalls, wave action and sedimentation. While SLAMM offers many advantages over bathtub inundation models, it requires expert handling, high quality data inputs, and takes longer to run. Table 1 summarises several differences between the two models.

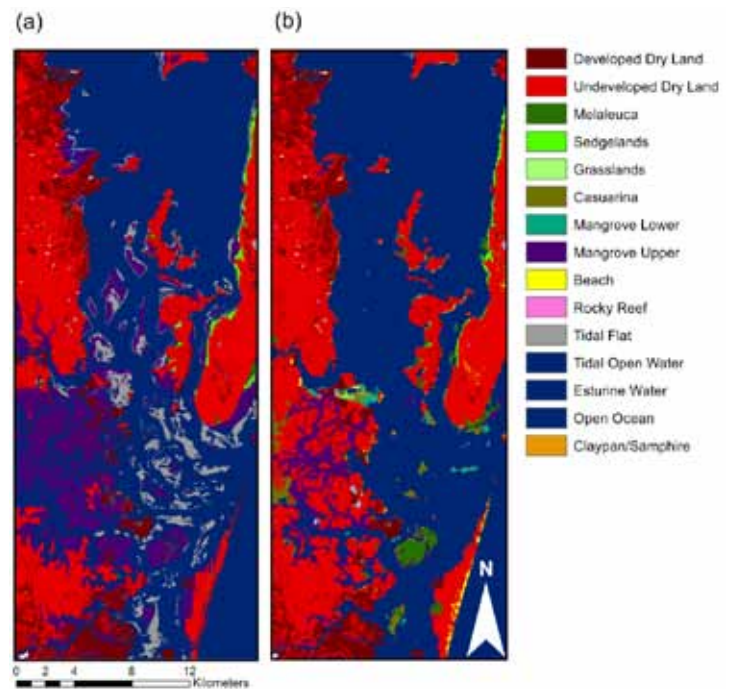


Figure 1: Wetland distribution produced from the (a) complex model with fine resolution elevation data and (b) the simplistic model with coarse elevation data for the mid-range sea-level rise scenario.

Simple (Inundation)	Complex (SLAMM)
Needs only basic skills	Requires an expert
Omits key processes	Incorporates key processes
Immediate results	At least 1 month before results
Minimal datasets required	Requires more datasets
Prone to inaccuracies	Higher level of accuracy

Table 1: A comparison of the simple (inundation) and complex (SLAMM) models.

In addition to the type of model being used to estimate impacts of sea level rise, there's also the question of the quality of the elevation data that will be used in the model. Elevation data is a critical input into these models as minor changes in elevation (in the order of centimetres) can drive key processes. We compared a coarser (30m resolution) and finer (5m resolution) elevation dataset.

As might be expected, the fine resolution data and the more sophisticated SLAMM modelling approach both came at a significantly higher cost. The question then is what combination gives you the greatest conservation bang for your limited conservation buck. The benchmark for answering this question was the conservation value of the wetland distribution in 2100 mapped using the best available model and data (SLAMM + fine resolution data). Conservation value was calculated using a metric from the systematic conservation planning software called Zonation (ie, weighted range size corrected richness).

We initially determined how much of this conservation value could be achieved by just using the simple bathtub model and coarse data (the cheapest option available) for 150 budget levels (up to \$50 million). Conservation priority areas are selected using these modelled outputs. However, these outputs often miss the areas of high conservation value (ie, important wetlands may be mapped as open ocean). This means that much more land must be purchased to get the same conservation value that could have been achieved if the best models and data were used instead.

Conservation priority areas were also selected using the more expensive modelling outputs (SLAMM + finer scale data). We then determined how much less it would cost (just in terms of land purchases) to achieve the same conservation value using these more accurate modelling outputs. This represents the maximum amount you could spend on using SLAMM and finer scale data without

forgoing any conservation value in the landscape (ie, the break-even cost). The expectation is that that even though less area is put into the network, because it's based on better information the land selected will be of greater conservation value.

Different results for different combinations

The various model-dataset combinations produced quite different distributions of vegetation types by 2100 (Figure 1). As the overall budget increased, so did the maximum amount that could be spent on acquiring the complex model and fine resolution elevation data without forgoing any conservation benefit relative to applying the simplistic model and coarse elevation data (ie, the break-even cost).

Our analysis suggests that for the upper sea-level rise scenario it was worth spending up to 99% of the budget on acquiring the high quality data. The break-even cost for the mid-range and lower sea-level rise scenarios was also a large proportion of the total budget (with a mean of 82% and 64% respectively).

In other words, whilst adopting a more accurate approach may mean less land is acquired in terms of overall area (because you've spent some of your money on modelling and data), the land that is acquired would be of greater conservation value than the cheaper approaches. This is because the cheaper approaches tend to omit areas of important conservation value in the prioritisation process by mistake. Sometimes, using these less accurate outputs meant that you could never achieve the same conservation value (no matter how much money you spent), as the areas that are important for conservation didn't exist on the map!

It is important to note that a higher predicted sea-level generally increased the cost-effectiveness of complex models and fine resolution data. Higher rates of sea-level rise meant there was a greater change in the initial vegetation distribution (relative to the low sea-level rise scenario); hence there was a greater chance for the simple model to incorrectly predict this distribution.

Information for sea level rise

Investing in detailed information doesn't always improve the conservation outcomes (see [Decision Point #27](#), p8, for a story on the diminishing returns from investing in acquiring more survey data). However, when developing a conservation adaptation plan for sea-level rise as we have here, investing in more detailed information is a highly advisable action. We demonstrated that it is considerably more cost effective to use the process-based model and high-resolution elevation data, even if this requires a substantial proportion of the project budget to be expended (Figure 2).

This suggests that when developing conservation plans in areas where sea-level rise threatens biodiversity, investing in high-resolution elevation data and process-based models to predict shifts in coastal ecosystems may be highly cost effective. Whilst these findings may not hold in all situations, particularly those with consistently low topographic relief or in a vastly different economic context, they were consistent across a range of sea-level rise predictions and budget levels.

This suggests that investing a substantial proportion of the conservation budget in better quantifying both biological and physical processes can lead to better conservation outcomes when resources are limited. 🍎

More info (or a copy of the paper):
Rebecca Runting r.runting@uq.edu.au

Reference

Runting RK, KA Wilson & JR Rhodes (2013). Does more mean less? The value of information for conservation planning under sea level rise. *Global Change Biology* 19: 352–363.
DOI: 10.1111/gcb.12064

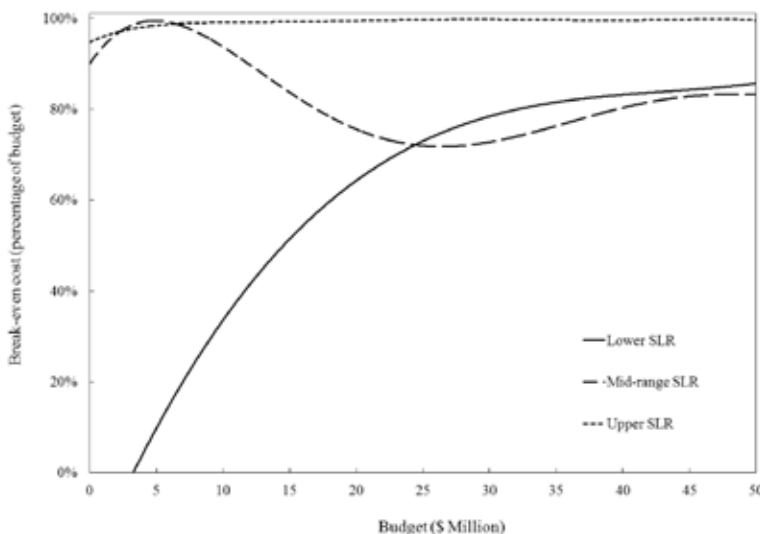


Figure 2: The maximum amount that could be spent on acquiring the complex model and fine resolution elevation data without forgoing any conservation benefit relative to the simplistic model and coarse elevation data (ie, the break-even cost).

Developing and interpreting species distribution models

A checklist of the basics

By Brendan Wintle (EDG, University of Melbourne)

Species distribution models (SDMs) combine observations of species occurrence or abundance with information about environmental variables to gain ecological insights and to predict species' distributions across landscapes. SDM outputs usually include:

- (i) a document describing the data and statistical modelling process used to generate the SDMs,
- (ii) a summary of the resulting numerical or statistical model, and (iii) a map of the probability of a species' occurrence over a region of interest (or the relative likelihood of occurrence in different parts of the region in the case of models that use only presence records).

Maps of the probability of occurrence generated by SDMs have been used in conservation planning and for the management of habitat at finer scales (eg, for identifying critical habitats to avoid during timber harvesting). They have also been used widely in the development of spatially explicit population viability analysis models (see the next issue of DPoint). The underlying statistical models of SDMs are useful for ecological inference, allowing analysts to statistically quantify the influence of particular environmental variables (eg, climate and rainfall) or management practices (eg, harvested, not harvested) on the probability that a species will occupy (or persist in) a given area.

The quality and reliability of SDMs depends on the quality and appropriateness of the field survey and environmental data inputs, the expert opinion and statistical methods underpinning the modelling process, and the recognition and treatment of uncertainty in the model outputs. SDMs may be referred to as habitat models, ecological niche models and a host of other names which some academics spend a little too much time arguing about (eg, Araujo & Peterson 2012. Ecology).

Input data

1. Survey data types

There are three broad types of species survey data (hereon referred to as species data) which can be used to build SDMs; presence-only data, presence-absence data (also known as detection/non-detection data), and abundance data. It is important to ensure that the data type being used is appropriate for the proposed use of the SDM. By far the bulk of SDMs are built using presence-only data, which means that the predictions of the SDM cannot usually be interpreted as probabilities but rather an indication of the relative suitability of different parts of the environment. When imperfect detection of species during biological surveys is an issue (see DP#66: fauna survey checklist), data can be collected in a way which allows simultaneous modelling of detectability and occupancy or abundance. Imperfect detectability is an especially important issue when the aim is to estimate occurrence probabilities or absolute abundance across a study region.

Check: Is the data type being used justified given data availability and the purpose of the SDM? Will the resulting SDM outputs be informative and meaningful given project objectives?

2. Evaluate data quality

Ideally, biological survey data collection would be planned in advance of a distribution modelling exercise to ensure appropriate stratification and replication across key environmental gradients such that the resulting models would provide a faithful representation of species habitat requirements. However, this is seldom the case and more often existing data must be utilized. Therefore, a review of the quality, age, bias, and geographic and environmental coverage of the existing species data being used in the modelling should be undertaken. The need to collect new data to fill gaps in coverage/stratification or to provide sufficient replication to develop reliable SDMs should be evaluated. Old and spatially- or environmentally-biased data (eg, data which have been collected close to roads, only in forests on particular tenures, only within a small subset of the potential range of interest) can

be misleading in SDMs developed for the purposes of defining critical habitats, total current habitat extent, and estimating overall proportion of the landscape occupied by the species. Using data derived from surveys with insufficient sampling effort to detect species of interest will lead to poorly calibrated models (see previous checklist on fauna surveys).

Check: Has an evaluation of the quality, age, bias and geographic and environmental coverage of the data been undertaken? Have data gaps been filled where necessary? Have old and poor quality data been excluded from model development? Is the data of sufficient quality given the likely application of the model and the accuracy and precision demanded of the SDM output?

3. Environmental data

Spatially referenced data layers (generally stored in GIS) are often used as 'independent variables' in the construction of SDMs and in the process of predicting the probability or relative likelihood of occurrence of a species throughout the landscape. The quality and relevance of the environmental data determines the quality of SDM output maps. The environmental data used in SDM development must represent the key habitat requirements of the species if the resulting SDMs are to be a useful guide to the location of critical habitat or the total extent of suitable habitats. If significant components of a species habitat requirements are not mapped (or are not mappable), reliable and useful SDM predictive maps cannot be produced.

Check: Has a review of the available mapped GIS environmental data layers in relation to key habitat requirements of the species been undertaken? Have gaps in availability of key habitat variables been filled and/or addressed as necessary?

4. Site-level or visit-level variable in SDMs

It is common in ecological or impact assessment studies to model independent variables that are measured at survey locations even though they are not mapped or mappable at broad scales. Even when the aim is to model and predict habitat occupancy across large areas, the incorporation of site/visit level variables can be used to 'control' for site or visit level effects in the modelling process (improving estimation of the importance of mapped variables). However, if the aim is to utilise models to map suitable habitat across a landscape, region or continent, at least some of the variables in the model must be mapped at the scale of interest.

Check: Have relevant site-level variables been included or considered in the model development?

5. Match scales of variables

The scale (resolution and extent) of mapped environmental variables must match the scale of use and the species biology. Environmental variables may be mapped at different resolutions depending on the nature of the variable and the data collection method used. For example, digital elevation data may be able to detect subtle variation in elevation over distances of less than a few metres, while variation in soil properties can rarely be mapped with spatial accuracy better than 200 metres over large areas of forest, and variation in climatic variables is seldom relevant over less than 2 kilometres. If management decisions demand accurate mapping of habitats to within 10 metres and fine scale variation in habitat does matter to a species of interest, then it is crucial that the relevant habitat variables are accurately mapped at an appropriately fine scale. For this reason, SDMs constructed solely on coarsely mapped climate variables are unlikely to be useful for supporting habitat management decisions in which boundaries must be accurately mapped to within 5-10 metres. However, combinations of coarsely and finely mapped habitat variables may be used to develop SDMs capable of informing habitat management decision making with a high degree of spatial precision.

Check: **Have independent environmental variables included in SDMs been mapped at a resolution and accuracy appropriate for management?**

Modelling methods

6. Identifying candidate models

Good practice in SDM development involves using a combination of expert judgement and statistical analysis to identify a set of plausible competing models that do a good job of explaining observed variation in species occupancy data, but which are not too complex ('over-fitted') relative to the amount of species data available. A few approaches to model selection exist, which emphasise the role of the expert opinion and statistical analysis to a greater or lesser degree. The choice of the most appropriate approach depends on the level of access to authoritative experts, the degree to which experts agree with each other, the amount of species survey data available and the degree to which statistical models agree with expert opinion. There is ample published advice on how to identify a set of plausible competing models.

Check: **Has the approach to model identification been justified with respect to published advice, and the availability of species survey data and expert opinion?**

7. Model ranking

It is unusual that a single model far outperforms all other competing models. This is known as model selection uncertainty because we are generally uncertain about which of a set of plausible models is the best. Therefore, it is good practice to present all of the models which provide plausible representations of how environmental variables influence the probability that a site will be occupied by the species of interest. Each model can be evaluated using an information criterion such as Akaike's Information Criterion (AIC; see supporting materials) which assesses how well the model strikes a balance between explaining variation in the species occurrence or abundance data and minimizing complexity. The information criterion score for each model should be presented to enable reviewers to assess the relative plausibility of the competing models.

Check: **Has an information criterion score been presented for each plausible model being considered?**

8. Dependent and independent variables

The terms (or 'coefficients') in a statistical model indicate how the dependent variable (e.g. probability of species occurrence or species abundance) varies with changes in an environmental variable. In many cases, these relationships may be non-linear functions and may also be used to represent the strength of interactions between independent variables that impact on species occupancy or abundance. These relationships should be represented graphically (see supporting materials) to allow reviewers to confirm that relationships are ecologically plausible.

Check: **Have the statistical relationships between environmental variables and species occupancy (or abundance) been provided in a clear graphical form?**

9. Statistical evaluation & cross-validation

Model evaluation is a critical part of SDM development because it provides an indication of the robustness of predictions of species distribution. Ideally, model evaluation is undertaken by comparing the predictions of the model to new field observations that were not used in the construction of the model. Because it is not always possible to collect a completely new model evaluation field data set, it is common to separate the modelling data into model-fitting and model-evaluation sets within a process called cross-validation. There is ample published advice on practical approaches to model evaluation including cross-validation (see references section).

Check: **Has model evaluation been undertaken (and model predictive performance reported)?**

10. Model diagnostics

Model diagnostics indicate any statistical issues that may impair the ability of the model to provide good inference about key habitat dependencies or good predictions of the spatial distribution of the species and its critical habitats. For example, model diagnostics can indicate whether model residuals (the differences between observed and fitted values) are normally distributed. If they are not, then model coefficient estimates may not be reliable. Presenting and discussing the outcome of model diagnostic tests for the most plausible models in the model set is good practice.

Check: **Have model diagnostics been presented and discussed?**

Outputs

11. Presenting plausible competing models

It is common practice to present SDM output maps (habitat maps) for only the 'best' of the plausible competing SDMs (assessed using AIC or cross-validation evaluation). This is reasonable because it is not ideal for managers to be dealing with more than one map of habitat for a particular species. However, there is a danger in this practice because plausible alternative models may be capturing something about the environment that is important to the species but which is overlooked by the 'best' model. Therefore, it is important that all areas predicted to be important habitat by plausible competing models are represented so that they can be considered and ground-checked during management decision-making processes.

Check: **Have output habitat maps produced by the 'best model' and the 'most competitive' of the non-preferred plausible models been presented and considered? Has the relative statistical support for each model been presented using AIC or equivalent criteria?**

12. Simplifying maps

It is common practice to convert maps which provide continuous predictions of occurrence probability or abundance into a binary map representing habitat/not habitat or other categorical presentations such as high/moderate/low quality habitat. This is achieved by identifying a threshold level of occupancy probability (habitat quality or abundance), below which areas will be considered unsuitable. If handled incorrectly, this process can lead to the loss of important habitat areas and is generally not recommended. However, if there is a compelling reason to do so, there is published advice on how to identify defensible thresholds for habitat maps.

Check: **For cases in which map outputs must be classified into categories, has this been done in accordance with published advice?**

A few good references

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A Summer Camp with edge

Reflections on the 2012 SCCS experience

By Michelle Venter (James Cook University)

- They came together in Brisbane in January with the hope of discovering kindred spirits in conservation science, and they left feeling they were part of an international network of young researchers hungry to make a difference. More than 100 post-graduate students from 30 countries in the Asia Pacific attended the inaugural Student Conference on Conservation Science at the University of Queensland.
- They heard presentations from some of the world's top conservation scientists; witnessed historic amounts of precipitation (as south east Queensland was again deluged by monsoonal rain); experienced some of Australia's iconic wildlife; and donated more than a few mills of blood to opportunistic leeches and mossies (as does everyone visiting rainforests in the middle of a big wet).
- I participated in a couple of workshops at the end of the conference and was amazed at the levels of enthusiasm and vitality shown by the student participants, this at the end of a gruelling two-week schedule. It's hard to encapsulate the spirit or the value of such an event in written words as one conference usually sounds somewhat similar to most other conferences. However, Michelle Venter, a student participant from James Cook University, has had a go in the story below. And I think she's done a good job of conveying that this SCCS, the first ever in the southern hemisphere, was pretty special.
- David Salt
- Decision Point

Can you imagine a hundred keen post graduate students from 30 countries gathered in one place for ten days of talks, workshops and exchange forums? To me, it was reminiscent of a pleasant summer camp experience, a bubble in time where you learn new skills, form lasting friendships and grow as a person. By the end, you find yourself exhausted and happy to return home, but still wishing it could have lasted a bit longer.

So far in my PhD, I have participated in a half dozen conservation and ecology conferences. Unlike the rest, the Student Conference on Conservation Science hosted by UQ in Brisbane in January 2013 was the first one designed specifically "for post-graduate students only". With this in mind, I honestly didn't know what to expect.



SCCS 2012: A feast of knowledge, networking and skills-building. Pictured here are students during one of the plenary sessions. (Photo by Mohan Gurung)

“I know that among their ranks will be some of tomorrow’s heavy hitters in the arena of conservation science.”



Rainforest with rain (and leeches by the dozen). Students take a break from the formal part of the conference to enjoy a walk on the wet and wild side in Lamington National Park. (Photo by Mohan Gurung)

Shortly after arriving I discovered, to my surprise, more than a dozen other students at the conference were working on very similar topics to mine. These young experts from all over South East Asia and the Pacific were actively involved with REDD+, a policy mechanism that aims to providing incentives for reducing emission from forest loss while improving forestry practice, conservation and local livelihoods.

The students working on REDD+ issues came from Myanmar, Cambodia, Nepal, Indonesia, Philippines, Fiji, Papua New Guinea and Canada; with undergraduate disciplines ranging from ecology, forestry, law and biology. Although we came from different places and backgrounds, we soon discovered that we had many things in common. All of us had spent some time working in remote resource-

Flavours of the SCCS

To get a flavour of the event, see the video clip put together by UQ's Journalism and Communication crew at <http://vimeo.com/58077222>

And the QAECO crowd (Quantitative and Applied Ecology at the University of Melbourne, the Melbourne node of the Environmental Decision Group) were heavily involved in the conference and QAECOLOGISTS Micha, Gerry, John, Darren and Will have written up their impressions at <http://qaeco.com/2013/02/05/qaecologists-at-sccs-brisbane-2013/>



Birds of a feather: Michelle with fellow SCCS students with an interest in REDD+. From left to right are Mohan Gurung (Nepal), Michelle Venter (Canada/Australia), Carol Moet Moet Aye (Burma) and Yeang Donal (Cambodia).

“Shortly after arriving I discovered more than a dozen other students at the conference were working on very similar topics to mine. These young experts from all over South East Asia and the Pacific were actively involved with REDD+.”

dependent communities and all of our projects were necessarily interdisciplinary, encompassing elements of conservation science, policy, landholder values and forest management.

Nearing the conference's close, in a session called 'Birds of a Feather', delegates aggregated into groups to discuss a topic of their choice. We quickly formed a REDD+ group as a formal way for us to share our experiences of common barriers in our work, of which we soon discovered there were many. However, early in the discussion things moved from doom-and-gloom to a focus on constructive opportunities for REDD+. We shared lessons learnt, discussed our future work plans and reflected on our common interests.

We came to a consensus that in the long run, REDD+ has potential to achieve important climate and conservation outcomes. We also agreed that for these global objectives to be met, a holistic approach to REDD+ was the key, whereby meeting the needs of local communities engaged in sustainable resource management is a paramount. Our discussions revitalised us and I left with greater confidence about my research goals.

These ten days at the University of Queensland were more than just a conference. In the second week, we enjoyed four days of workshops in which we had the opportunity to choose from sixteen skills-based tutorials lead by experts in a variety of fields. Some of the workshops were on different forms of communication including scientific writing, oral presentations and media skills. Others were more focussed on science skills and environmental decision theory including workshops on a variety of statistical techniques and software as well as training for MARXAN (software created by a team of researchers at UQ for conservation planning).

In a sense, this conference was a capacity-building exercise for young conservation practitioners, and those capacities revolved around knowledge, networks and skills. I for one have benefitted immensely from the experience, and I'm grateful to all the organizers and funders of the first of hopefully many future SCCS's. 🍷

A win for regional biodiversity

The SCCS exceeded my expectations. We brought together students from throughout the region and I know that among their ranks will be some of tomorrow's heavy hitters in the arena of conservation science. I hope that when some of these high achievers look back over their career paths that they will see this student conference as having been an important stepping stone.

It was also a special event because, while we used a template that has been tested in other places like Cambridge University, this is the first time such an operation has been run in the southern hemisphere. That it worked so well is testament to almost 60 enthusiastic volunteers and organisers mainly based here at the University of Queensland (with considerable input from members of the Environmental Decisions Group from around Australia).

We're proud of what we've achieved and I think Australia as a nation should acknowledge the importance of events such as these. Australia needs to shoulder its responsibility more when it comes biodiversity conservation in the region (much as we shoulder regional responsibilities with respect to human rights and health). I estimate that somewhere between Burma and Fiji, taking in Brisbane on the way, there are about a third of all terrestrial species on the planet packed into 10% of the world's land. And if we dive into the marine realm, the Coral Triangle, which lies the middle of that broad transect, has no parallel on the land in terms of the richness of its marine biodiversity. Yet many of the countries in our region have limited capacity to do the conservation research that's needed. Training and skills in ecology, conservation, GIS, communication and conservation economics is absent or limited. The SCCS is one small action we can take as a nation to help redress this situation, but it's only a start.

So, well done Team SCCS – organisers and participants. May this be the first step in a longer journey that sees our region's best and brightest students working more effectively together to tackle the enormous challenges of conserving our precious biodiversity.

And many thanks to the Thomas Foundation (www.thomasfoundation.org.au), the principal sponsor of this first ever SCCS in Australia.

*Hugh Possingham
Convenor of the 2012 SCCS*



Final drinks: Hugh Possingham hands out awards at the celebrations marking the end of the SCCS.



Thinking through a big decision

Pictured above is decision scientist Mike Runge workshopping the problem of what to do about invasive willows in Victoria's alpine bogs. Mike, a world authority on adaptive management and structured decision making, is a long-time associate of the EDG and a frequent visitor to our labs (he's based in the US). He worked with Joslin Moore and Parks Victoria on the problem of the invading willows, and together they came up with a robust solution. The key decision was about what proportion of resources should be allocated to the management of existing populations of willow in bogs as opposed to locating populations of willow that may serve as sources of colonists in the future. It may not sound that big a decision but Parks Victoria, the agency responsible for management of the Bogong High Plains, considers the invasion by gray sallow willow as one of the main threats to persistence of the bogs. So, the stakes were very high, the uncertainty enormous and the budget completely inadequate! Sounds like a job for good decision scientist. See what they came up with on page 6. 🍀

What's the point?

Concern dries up when it rains

According to figures recently released by the Australian Bureau of Statistics (ABS), Australians' concerns about the environment have lessened over the past few years, and they feel the natural environment has improved.

ABS Director of Environmental Surveys, Caroline Deans, said the recent environmental attitudes survey asked questions across a range of environmental concerns and practices, and showed some major changes in the way Australians are now viewing the environment.

"Fewer people today are saying they are concerned about the environment," says Ms Deans. "Just four years ago, eight in ten adults were concerned about environmental problems. In this latest survey we've seen that drop to six in ten.

"Half of Australia's population now rates the condition of our natural environment as good; this is up from our last survey where the rate was less than one third.

"This drop in concern about environmental problems in general coincided with good rainfall across much of Australia over the last few years which has also led to fewer people worrying about water shortages." 🍀

More info: <http://www.abs.gov.au/ausstats/abs@.nsf/latestProducts/4626.0.55.001Media%20Release12011-12>

Editor's note: This report was released on 11 December 2012. I wonder if the community would still be so unconcerned following the historic heat wave, fires and flooding experienced this summer.



ENVIRONMENTAL DECISIONS GROUP

The Environmental Decision Group (EDG) is a network of conservation researchers working on the science of effective decision making to better conserve biodiversity. Our members are largely based at the University of Queensland, the Australian National University, the University of Melbourne, the University of Western Australia, RMIT and CSIRO.

The EDG is jointly funded by the Australian Government's National Environmental Research Program and the Australian Research Council's Centre of Excellence program.

Decision Point is the monthly magazine of the EDG. It is available free at: <http://www.decision-point.com.au/> If you would like to contact *Decision Point*, see page 2.

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