DECISION P●INT

Connecting conservation policy makers, researchers and practitioners

Now you see me...

...now you don't!

Imperfect detection and species distribution modelling

Introducing Eremaea ebird

In the marshes of Madagascar

Aiming for SMART targets for NRM plans

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/
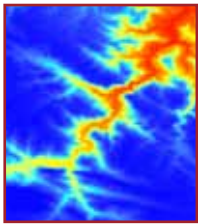
Plus

Conservation in a 'wicked' world
Offsetting seagrass meadows
Cost-effective restoration for birds
Urban biodiversity talk

DECISION P INT

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How do you account for hard-to-find species like the Alaotran gentle lemur (pictured here) when modeling its distribution. See page 6 for the answer. (Photo by Gurutzeta Guillera-Arroita).

On the point

It takes all sorts

Effective conservation involves the engagement of multiple players. It is not the sole preserve of any single discipline, say ecology for example, and it's often through partnership that some of our biggest conservation breakthroughs are made. This issue of Decision Point highlights this very fact in spades.

Up front we discuss a collaboration between ecologists and lawyers (Offsetting coastal development, pages 4,5) in which the concept of marine offsets is put under a legalistic lens. It's discovered that provisions for offsets on land don't work so well under the high-tide mark.

Dean Ansell explores the notion of cost-effectiveness of restoration plantings from the farmer and the ecologist's point of view (Getting more bird for your buck, pages 12,13). He suggests that cost-effectiveness depends on how you frame the question, and it's not just how much money you spend or even how many species you bring back.

Economists working with agricultural extension officers question just how SMART (Specific, Measurable, Achievable, Relevant and Time-bound) our NRM performance goals are (Taking on NRM performance goals, p8). They do a census of planning goals in Victoria and NSW and the results suggest we need to be way SMARTer in the way we assign targets.

Of course, when it comes to multiple players, citizen science leaves most other conservation efforts well behind. We've done several stories in the past on the value of citizen science and how it can be better harnessed. In this issue, the EDG is proud to announce a new association with two of the world's biggest online citizen science bird atlases – Eremaea and eBird (Two online birds in the hand, pages 10,11).

When you think about it, conservation needs multiple inputs and perspectives because the world is a complex place. Eddie Game and Eve McDonald-Madden make the case that conservation stands to learn a lot from the science of complex systems (see page 9).

Which just goes to show, effective conservation takes all sorts. 🌶

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Short accounts of papers from EDG researchers. If you would like copies of any of these papers see: http://decision-point.com.au/research-briefs.html

Monitoring endangered species to death

David Lindenmayer and colleagues have asked what's the point of monitoring threatened species if there's no plan to do something when population levels drop to dangerously low levels? Many wildlife programs round the world are monitoring species to the point of extinction – often without taking the necessary action to save them. The scientists cite 34 cases – mainly mammals and amphibians – from all around the world where the species have become locally or totally extinct while they were being monitored. Examples include the Channel Island fox, the Vancouver Island marmot, the West African black rhino and the Christmas Island pipistrelle bat. They also used the case of Booderee National Park (NSW), where the once common greater glider underwent a disastrous decline and disappeared totally in 2007. This followed the local extinction of the yellow-bellied glider in the same park in the 1980s.

"The original monitoring plan for Booderee did not include trigger points for action – maybe because of lack or resources or uncertainty over why these animals were becoming extinct. But on the basis of this experience we feel it is possible to include triggers in many future conservation monitoring programs," says Lindenmayer.

The team has recommended a new approach be adopted globally:
• All conservation monitoring programs should contain well-defined trigger points for pre-planned action
• Management intervention should occur when it becomes clear that a monitored species is in decline
• Conservation science should document and learn from cases where there was a failure to save a species.

Reference

Lindenmayer DB, MP Piggott & BA Wintle (2013). Counting the books while the library burns: why conservation monitoring programs need a plan for action. *Frontiers in Ecology and the Environment*.
http://dx.doi.org/10.1890/120220

The undermining of Australia's nature reserves

Against a global backdrop of rapid environmental change, conserving biodiversity poses one of the biggest and most important challenges to society. For this reason, systems of nature reserves have never been more important.

In recent decades, the Australian state and federal governments have collectively built a system of terrestrial and marine conservation reserves that forms the cornerstone of biodiversity conservation on the continent. The network aspires to be both comprehensive and adequate. The resulting national reserve system is imperfect, but it goes some way toward protecting Australia's unique species and ecosystems. That system is now being systematically undermined, even though continental-scale biodiversity losses are underway.

Protected areas are under threat in many parts of the world but the weakening of protected areas in a rich, developed country like Australia with a global reputation for conservation leadership is particularly alarming. Consequently, the authors on this paper in *Conservation Biology*, including several EDG researchers, are concerned about the recent spate of substantial policy, legislative, and management changes being made by three of six Australian state governments for exploitative uses of national parks—actions that could affect much of Australia and have negative effects on biodiversity.

Reference

Ritchie EG, CJA Bradshaw, CR Dickman, R Hobbs, CN Johnson, EL Johnston, WF Laurance, DB Lindenmayer, MA McCarthy, DG Nimmo, HP Possingham, RL Pressey, DM Watson & J Woinarski (2013). Continental-Scale Governance and the Hastening of Loss of Australia's Biodiversity. *Conservation Biology* 27: 1133–1135.
http://onlinelibrary.wiley.com/doi/10.1111/cobi.12189/abstract

"The weakening of protected areas in a rich, developed country like Australia with a global reputation for conservation leadership is particularly alarming.**"**

Cumulative impact maps and where to act

Cumulative impact maps are used to identify the spatial distribution of multiple human impacts to species and ecosystems. These impacts might be caused by local stressors or global stressors. Local stressors can usually be managed to some degree by local action (eg, nutrient build up can be dealt with by actions that improve water quality). Global stressors, on the other hand, usually cannot be dealt with directly by local managers (eg, climate change). Cumulative impact maps typically assume that there are no interactive effects between stressors on biodiversity. But is that a valid assumption? Chris Brown and colleagues set out to explore this. Their aim was to determine whether the assumption of no interactions in impact maps leads to the incorrect identification of sites for management.

They used the additive effects model to incorporate the effects of interactions into an impact map. As a case study they used seagrass meadows in Australasia which are threatened by a local stressor (nutrient inputs), and a global stressor (global warming). The reduction in the impact index was quantified for reductions in the nutrient stressor. They examined the outcomes for three scenarios: no interactions, antagonistic interactions (where impacts of stressors work against each other) or synergistic interactions (where impacts of stressors magnify each other).

The assumption of no interaction implies that reducing a local stressor will give equivalent reductions in the impact index everywhere, regardless of spatial variability in a global stressor. This analysis showed that reductions in the impact index were greatest in refuges from warming if there was an antagonistic interaction between stressors, and greatest in areas of high warming stress if there was a synergistic interaction. Reducing the nutrient stressor in refuges from warming always reduced the impact index, regardless of the interaction.

These results demonstrate that interactions between local and global stressors should be considered when using cumulative impact maps to identify sites where management of a local stressor will provide the greatest impact reduction. If the interaction type is unknown, impact maps can be used to identify refuges from global stressors, as sites for management.

Reference

Brown CJ, Saunders MI, Possingham HP & Richardson AJ (2013). Interactions between global and local stressors of ecosystems determine management effectiveness in cumulative impact mapping. *Diversity and Distributions*. doi: 10.1111/ddi.12159
http://onlinelibrary.wiley.com/doi/10.1111/ddi.12159/full

Plus see *Decision Point #72* for Chris Brown's story on synergistic and antagonistic interactions.

Offsetting marine and coastal development
Are seagrass meadows the same as terrestrial ecosystems?

By Megan Saunders, Justine Bell and Hugh Possingham (University of Queensland)

Offsetting has become an important part of the government tool box for minimising environmental impacts and EDG researchers have been at the forefront of developing offsetting tools and concepts for the Federal Department of the Environment (see the box on 'offsets assessment').

When this work was being done, the things being primarily focussed on were largely on terra firma, and concerned matters like black cockatoos or listed terrestrial habitats. Of course, developments that impact on biodiversity aren't restricted to the land as recent proposals for port developments demonstrate. So the question is – does the government's offsetting policy work in the sea?

When we examined the environmental legislation underpinning the offsets policy under a legal lens we found that it may not adequately protect vulnerable marine ecosystems (Bell et al., 2014). Without amendments to the offsets policy, iconic habitats such as coral reefs, seagrass and mangroves, could all pay a heavy toll.

Biodiversity losses at sea

The new Environmental Offsets Policy, a component of the Environment Protection and Biodiversity Conservation (EPBC) Act, was released in October 2012. The policy allows 'unavoidable' losses of biodiversity attributed to development to be 'offset' by protecting or rehabilitating an equal or greater quantity of that same biodiversity elsewhere.

The policy was developed specifically for terrestrial ecosystems, but applies equally to marine ecosystems. For instance, it was recently used to guide the environmental permission for the expansion of the Abbot Point coal terminal in the Great Barrier Reef World Heritage Area (see the box on 'Abbot Point coal port').

Marine ecosystems, however, are fundamentally different to terrestrial ecosystems in a number of key areas. This could

> **"Without amendments to the offsets policy, iconic habitats such as coral reefs, seagrass and mangroves, could all pay a heavy toll."**

significantly affect the success of offsetting strategies and could gravely threaten the marine habitats the policy is designed to protect. In comparison to terrestrial ecosystems, marine ecosystems:

- Exhibit faster rates of response and higher sensitivity to environmental variability
- Have significantly larger spatial scales of ecological connectivity
- Demonstrate 'alternate stable states': The effort it takes to rehabilitate a habitat may be significantly greater than the effort it took to destroy it.
- Are subject to 'diffuse impacts': Actions occurring far away can have deleterious impacts.

Sea meadows

Our research focusses specifically on seagrass meadows, the 'ugly ducklings' of shallow seas. While not offering the spectacular diversity and colour of coral reefs, seagrass meadows provide nursery areas for commercially important fish species; grazing areas for iconic species like sea turtles and dugongs; and a range of vital ecosystem services such as the stabilization of ocean sediments and water filtration. They are also one of the most intensive carbon sinks on Earth – burial rates of organic carbon in seagrass meadows (and salt marshes and mangroves) are exceptionally high, exceeding those in the soils of terrestrial forests by 30–50 fold.

So, seagrass meadows are important for a range of reasons. They are also one of the most threatened ecosystems on Earth, with staggering rates of decline around the globe in recent years. Dredging associated with coastal development is one of the major causes of this decline. The process of dredging directly damages seagrass plants and releases sediments into the water column which obscures the light the plants require to grow.

Acknowledging the difference

In that it provides a transparent and quantitative framework for mitigating losses, the EPBC Act Offsets Policy does make a sound contribution to protecting biodiversity. However, acknowledging the differences with terrestrial habitats (as we have outlined here), we recommend that a separate policy related to marine habitats be formulated. In the case of seagrass, this policy should include:

- Clear guidelines for selecting offset project sites;

Marine ecosystems, like seagrass meadows (above left) are quite different to terrestrial ecosystems like forests (above right). Among other things, marine ecosystems tend to be more sensitive to environmental variability, have larger spatial scales of connectivity and are subject to diffuse impacts.

- Consideration of diffuse impacts as threats to seagrass, as many threats to seagrass come from offsite (eg, agricultural run-off);

- Allowing proponents to remedy diffuse impacts as an offset activity, as traditional replanting or protection strategies used to offset terrestrial habitats are not always appropriate;

- An adaptive management approach to allow governments to assess a small number of projects before allowing offsets to be widely used; and

- Coordination between Federal and state policies.

As we've already said, seagrass meadows are a very special place. They hold important economic and environmental values in terms of serving as fishery nurseries and wildlife habitat. Once they were largely overlooked but these values are now widely acknowledged meaning the meadows of the sea now have high social value – loved by fishermen, greenies and dugongs alike. The coastal fringe is also a development zone that will see these values contested as other claims are made of these areas. A capacity to create appropriate offsets will be essential if we are going to effectively protect our biodiversity. This is going to be an exciting space to watch as issues of coastal development heat up. 🌶

More info: Justine Bell j.bell@law.uq.edu.au

Reference

Bell J, MI Saunders, CE Lovelock & HP Possingham (2014). Legal frameworks for unique ecosystems – how can the EPBC Act Offsets Policy address the impact of development on seagrass? *Environmental and Planning Law Journal*, 31: 34-46.

This paper was an output of an interdisciplinary research project conducted at the University of Queensland, TE Beirne School of Law, Global Change Institute, School of Biological Sciences, and the ARC Centre of Excellence in Environmental Decisions. The research was funded in part by the Australian Research Council.

A guide to the EPBC Act Offsets-assessment

Biodiversity offsetting involves compensating for environmental damage at one location by generating ecologically equivalent gains at another, so that there is 'no net loss'. Biodiversity offsets are increasingly being used as a regulatory tool to balance the needs of sustainable development and environmental conservation. Unfortunately, such schemes are often prone to failure due to poor design and implementation.

The Environment Protection and Biodiversity Conservation (EPBC) Act regulates impacts on matters of national environmental significance, such as nationally threatened species and world heritage areas as well as actions that involve the Commonwealth. The EPBC Act environmental offsets policy (released in October 2012) sets out the principles for effective offsetting for those protected matters regulated under national environmental law.

A biodiversity offset trade involves a loss of biodiversity at an 'impact' site being exchanged for a gain in biodiversity at an 'offset' site based on an 'offset action'. Usually, the amount of impact is estimated during the impact assessment process. But establishing the amount of biodiversity benefit generated at an offset site by the offset action is harder. That is because the gain in biodiversity at the offset is not the same thing as the amount of biodiversity the site currently supports.

More info: See *Decision Point 69* for the full story on the guide. Also see 'Balancing biodiversity offsets with restoration reality' in *Decision Point #63*.

Coastal development such as canal estates and coal facilities are exacting a terrible toll on seagrass meadows through direct displacement and impacts on water quality (increased turbidity and nutrient levels). Governments are looking at the possibility of creating offsets for this coastal development but are the rules that have been formulated for terrestrial offsets appropriate in marine settings?

The Abbot Point coal port

Abbot Point is the most northerly deepwater coal port in Australia, and is situated 25 kilometres north of Bowen, Queensland. Its value as a bulk port facility lies in the fact there are very few locations along Queensland's eastern seaboard where deep water (>15m) is close inshore. The port is planned to be expanded to provide export facilities for coal mined from the Galilee Basin in central Queensland (and involves the addition of a second wharf and shiploader, and onshore facilities). Once completed, it will be the largest coal port in the world. In December 2013, the Federal Government approved the expansion sparking outrage from conservationists given the facilities close proximity to the Great Barrier Reef World Heritage Area and the need to dredge millions of cubic metres of spoil for the coal port to be constructed.

Source: http://en.wikipedia.org/wiki/Abbot_Point

Now you see me, now you don't

The impact of imperfect detection on species distribution modeling

By Gurutzeta Guillera-Arroita & José Lahoz-Monfort (Uni of Melbourne)

All ecologists know that wildlife surveys are almost never perfect. Individuals are often missed and even whole species may remain completely undetected even though they are present. Imperfect detection has important implications for wildlife monitoring and species distribution modelling (SDM) and yet it has largely been overlooked in the SDM literature. In an attempt to better understand how imperfect detection affects SDMs, we simulated a range of different detectability scenarios. Our results highlight how managers and conservation workers can improve SDM practice by accounting for detectability (Lahoz-Monfort et al, 2014).

As a nice example of the problems of imperfect detection, consider the Alaotran gentle lemur in northeast Madagascar. It is the only species of primate that inhabits a wetland, and surveys are carried out by canoe along channels cutting through the dense marsh vegetation (see the image on page 16). Individuals can be easily spotted when they stand at the edge of the vegetation, but their detection becomes extremely difficult as soon as they move slightly deeper into the reeds and papyrus. You don't see them anymore, but they are still there.

Factors leading to imperfect detection

Failing to spot animals has direct implications for wildlife monitoring. When not taken into account, it leads to the underestimation of population abundance and species occurrence rates.

Many things contribute to how detectable a species is in a survey. It might be that the habitat of the Alaotran gentle lemur makes it hard

> **"Recording data in ways that allow the modeling of the detection process should become standard practice in future surveys."**

*Now you see it, now you don't! As with so many species, the Alaotran gentle lemur (*Hapalemur alaotrensis*) is difficult to detect in the wild. Due to the dense structure of most of its marsh habitat, individuals are easily missed unless they stand right at the vegetation edge (as pictured above). In the picture below, two individuals stand slightly deeper among the papyrus. Can you spot them?*
(Photos by G. Guillera-Arroita)

to spot, but their behavior of being able to stay still and quiet when people are around is also factor. How much effort is put into finding them is important. Just as important is the skill level of the people looking for them.

So detectability is the product of species and habitat characteristics, survey effort and observer skills, and it is therefore likely to vary in space and time. This variation amplifies the problem of imperfect detection as it can lead to the missing of relevant ecological relationships and trends, or the detection of spurious ones. Given that the modeling of species distributions is a fundamental tool in a wide range of applications in ecology, species management and conservation, it is important that the impact that imperfect detection can have is fully accounted for.

Probability of occupancy | Location of 30% best habitat

(Row labels: Real, Presence-absence SDM)
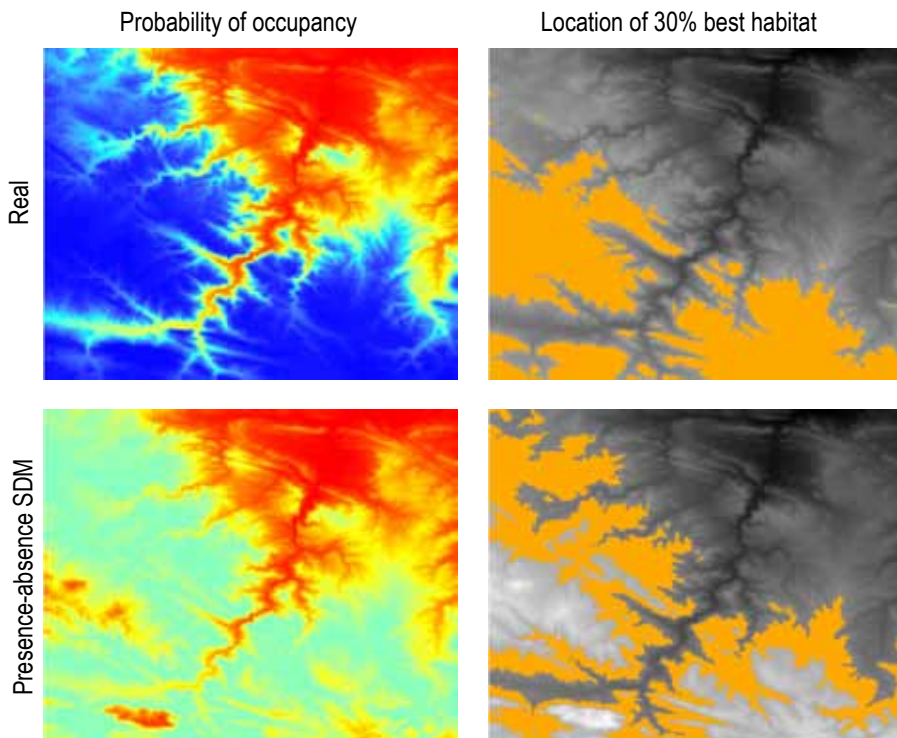
Figure 1: Impact of imperfect detection in the estimation of the distribution of a virtual species. In this example, occupancy increases with elevation while detectability decreases (ie, occupancy and detectability are negatively correlated). The colour range from red to dark blue corresponds to values from 0 to 1. If disregarded, imperfect detection causes the underestimation of species occurrence probabilities, especially at higher elevations (left column), and can lead to the misidentification of critical habitat (right column, in orange). (From Lahoz-Monfort et al., 2014).

Assessing the impact of imperfect detection

We used simulations to explore a range of plausible scenarios where detectability was either constant, a function of the same factor driving species occupancy, or a function of an independent covariate. Using these scenarios, we assessed the performance of three classes of modeling methods (based on presence-absence, presence-background and occupancy-detection data), looking at two key performance aspects: model calibration (ie, how well the predicted probabilities match the observed proportions of sites occupied) and discrimination ability (ie, how well the model distinguishes between occupied and empty sites).

The fact that imperfect detection can bias the estimation of ecologically relevant state variables is not new. However, it's largely been overlooked in the SDM literature. Furthermore, there has been confusion about its impacts and about the performance of models that explicitly account for detectability. Having this in mind, there are three key messages that arise from our results:

1. **Presence-background methods are also affected by imperfect detection.** Even if false absence records are avoided, imperfect detection may imply that presence records do not represent a random sample of sites where the species occurs, which leads to the biased estimation of environmental relationships. This means that presence-background methods such as Maxent are not any more immune to imperfect detection than presence-absence methods.

2. **The impact of imperfect detection depends on its relationship with the environment.** Disregarding imperfect detection is a greater problem when detectability is negatively correlated with species occupancy, or when it depends on independent covariates that are included as candidate occupancy predictors. Not only is model calibration impacted, but discrimination ability is also undermined (see summary

table). In practice this means that what seems the best habitat for the species may simply represent sites where the species is more easily observable (see example maps).

3. **Modeling detectability improves the performance of species distribution models.** Modeling occupancy and detection simultaneously does not necessarily require a greater sampling effort, but rather that data are collected so that they are informative about detectability. While all models may have similar ability to describe where the species is observed, only models that account for detectability provide a reliable estimation of where the species occurs (ie, true SDM). Past comparative studies that assessed the performance of SDMs by evaluating their ability to predict detections rather than presences failed to reveal the actual benefits of accounting for detectability.

So what can we conclude from all of this? Our recommendation is that recording data in ways that allow the modeling of the detection process should become standard practice in future surveys. Possible methods include recording the detection/non-detection of the species in multiple visits to sites, or inter-detection times within a single survey visit.

When such data are not available, diligent consideration and reporting of the possible impacts of imperfect detection, including how it is likely to bias inference and prediction, should be considered a minimum standard of good species distribution modeling practice. 🔴

Table 1: Summary of the impacts that disregarding imperfect detection can have on the performance of SDMs as a function of the structure of the detection process with respect to the occupancy process. Symbol ✗ represents that imperfect detection affects performance, and ✓ that it does not. This applies to both presence-absence and presence-background methods. Note that presence-background methods such as Maxent produce a suitability index rather than a probability and are thus not necessarily calibrated even assuming perfect detection.
(From Lahoz-Monfort et al., 2014)

Performance aspect	detectability structure			
	constant	varying		
		positive correlation	negative correlation	no correlation
Discrimination	✓	✓	✗	✗
Calibration	✗	✗	✗	✗

Taking aim at NRM performance goals

On being SMART and on target

By Caroline Mitchell (UWA)

It seems obvious that any organisation's performance goals should be based on achievable outcomes. But planning experts go further and suggest that, to be meaningful, an organisation's goals should be tangible and doable. To this end they need to be SMART, which stands for Specific, Measurable, Achievable, Relevant and Time-bound. Sounds like common sense but how many organisations operating in the natural resource management (NRM) sector actually use SMART targets in their planning? Geoff Park, an experienced knowledge broker working in the NRM space in Victoria, together with colleagues (including EDG's David Pannell) recently did a stocktake of NRM targets to test their SMARTness. What they found was disturbing.

"We looked at a specific set of targets set by Catchment Management Authorities in Victoria and New South Wales," says Geoff Park. "We examined these targets through several planning cycles commencing in 1997, and our focus was on targets relating to biodiversity, water and community engagement. We ended up examining hundreds of targets documented in over 50 regional plans. And it's worth noting these plans weren't done in isolation, they had all been endorsed by governments at different times across the two states."

The investigation focused on three of the five SMART categories, evaluating whether stated goals were Specific, Measurable and Time-bound. It was judged that the criteria of Attainable and Relevant required significant local knowledge and technical expertise that would be difficult to obtain for all regions in a comparable manner. What's more, if the targets failed on the other criteria it makes the notion of 'attainability' and 'relevance' a bit academic.

"Overall, we found that the quality of the targets was poor," says Park. "Less than 30%of the targets we reviewed met all three criteria. Some targets met one or two of the criteria, but most failed to meet all three.

"What's more, the proportion of targets that are Specific, Measurable and Timebound has not increased over time, and in New South Wales it has declined."

SMART targets are important for effective NRM planning but many regional NRM organisations don't use them. Researchers believe government agencies need to take the lead in this area, provide incentives for those organisations who do use SMART targets effectively, and place a greater emphasis on outcomes.

> **"A good place to start would be if governments made sure that all the targets of their own agencies followed SMART principles"**

To illustrate a non-SMART target, here is one from an Australian Government program: "To increase the opportunities for short-term members or visitors to contribute to and partake in the protection and management of natural resources." Clearly it falls short on all the three criteria – It is non-specific, it is unquantifiable and no time frame is specified.

The team's research is in line with the findings of the Australian National Audit Office (Auditor General, 2008) when it reviewed the regional natural resource management system. The ANAO also looked at a sample of targets and they found that around half were not measurable or time bound.

In addition, the ANAO provided some insights into the 'achievable' and 'relevant' criteria. They noted that there was little evidence to indicate whether targets were achievable, and that where there was evidence, the targets clearly were not achievable. "Where the impact on resource condition is identified by regional bodies, the expected results were often low (frequently less than one per cent of the longer term resource condition target)." They also observed that there was "little information" about whether targets represented value-for-money outcomes – which might be viewed as a reasonable basis for judging whether they were relevant.

"We think there are three main reasons for the low quality of targets we observed," says Professor David Pannell. "First there's a lack of appropriate standards and guidelines from governments to guide target setting; then there's a lack of realism about the costs and feasibility of ambitious environmental targets; and finally, there's a lack of adequate focus on outcomes by both CMAs and governments.

"Addressing these issues is a major challenge. A good place to start, however, would be if governments made sure that all the targets of their own agencies followed SMART principles.

"There's also a need to be more realistic about what is actually achievable as well as some form of positive feedback that rewarded regional bodies for adopting SMART targets.

"The only way we'll see a general improvement is if government agencies provide guidance and training, send strong signals that improvements are needed, and reward regional bodies that do practice outcome-focused accountability."

More info: David Pannell david.pannell@uwa.edu.au

Reference

Auditor General (2008). Regional Delivery Model for the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality, Audit Report no. 21 2007-08, Performance Audit, Australian National Audit Office, Canberra.

Park, G., Roberts, A., Alexander, J., McNamara, L. and Pannell, D. (2013). The quality of resource condition targets in regional natural resource management in Australia, *Australasian Journal of Environmental Management* 20: 285-301.

Plus see the Pannell Discussion on this topic at
http://www.pannelldiscussions.net/2013/11/258-how-many-environmental-targets-are-smart/

Conservation in a wicked world

It's tough because it's complex

By Eve McDonald-Madden (University of Queensland) and Eddie Game (The Nature Conservancy)

Conservation is not rocket science; it's far more complex. Rocket flight obeys well-understood laws, is predictable, and varies in only four dimensions. Most rockets reach their targets and, when they don't, the reasons why they didn't are likely to be obvious. Most conservation actions, in contrast, cannot be assured of reaching their target and the reasons for the failure are often poorly understood. The uncertainties are largely due to the fact that most conservation problems are embedded in socio-ecological systems possessing all the characteristics of 'complex systems': numerous interacting elements lacking any central control, nonlinear interactions between elements, constant change which is often irreversible, and no clearly defined boundaries to the system. These characteristics contribute to what have been come to be called 'wicked problems'. Wicked problems generally lack clear solutions because each problem is linked to other problems, and the nature and characterization of each cannot be isolated.

Of course, it's not just conservation that grapples with challenge of complexity. Complex systems (and the associated wicked problems) have been the focus of research in various fields including mathematics, psychology, social science, military studies and business management. Can we in the conservation game draw any insights from these other areas? That's the question we posed with colleagues Erik Meijaard (UQld) and Doug Sheil (Center for International Forestry Research), and we believe there's much we can learn (Game et al., 2013). In our paper we identified challenges for conventional conservation practice; specifically, the difficulty of adaptive management where success is ambiguous, and the tension between best practice and creativity. We also considered how modern military conflicts embody comparable challenges to achieving conservation targets, and offer suggestions for how conservation practices might change to better navigate complex systems and wicked problems (these are summarised in Table 1).

So here are a few of the things we identified in our engagement with complexity (read the paper for our full discussion). To begin with there is no 'right' solution to wicked problems in complex systems, only trade-offs that appear more or less favorable depending on your perspective.

The need to work in complex systems makes adaptive management highly appealing but ultimately incredibly difficult. Adaptive management has become a standard concept among conservation agencies with decisions about interventions being based on the current state of the system and feedback about the performance and impact of any previous and ongoing interventions. And yet adaptive management can be problematic. First, measuring performance in complex systems is tricky. Unless a conservation solution is an unmitigated disaster, the need for, or value of, other approaches might remain unnoticed or unconvincing. In our experience, changes in strategy, even in programs that profess to be adaptive, are rare.

Another way in which complex systems undermine adaptive management is related to their wickedness. In a wicked problem, implementing any given solution will change the nature of the problem, which in turn influences the performance of the solution and so on. An example of such behavior in conservation is how the purchase of land for conservation can accelerate subsequent development and the fragmentation of the surrounding areas.

And then there is the tension between 'best practice' and creativity. Conservation often emphasizes best practice with many conservation organizations supporting standardized planning methods (and then strongly encouraging partners to adopt similar approaches). Apart from the fact that claims of best practice are typically unsupported by comparative evidence (and are perhaps better considered as 'conventional' practice), their application to complex conservation problems often results in 'finding a good solution to the wrong problem'. Rather than adhering to nominal best practice, studies into successful management and leadership in complex situations consistently emphasize a willingness to disrupt existing behaviors and to be open and responsive to competing and creative options. We believe that a relatively unacknowledged tension exists between creativity and best practice in conservation. Fostering creativity requires leadership that is open to diverse inputs, and encourages discussion, dissent, and diversity.

Military campaigns confront the challenges of operating in a complex world all the time. After operating in Afghanistan for over a decade, the United States and its allies have come to realise that success in the field is not won through greater resources and tight top-down, centralised decision making. With experience and reflection they have opted for distributed leadership and a decentralized approach to strategic analysis, along with an acknowledgement of the need to listen to diverse voices during decision making. The shared characteristics between military and conservation challenges and approaches provide potential lessons, suggestions, and opportunities for conservation tactics and practice.

Acknowledging the systems we work in as complex and plagued with wicked problems allows us to learn from other fields facing similar challenges. Opportunities for progress lie in how we define and share objectives, how we use scenarios, and in our willingness to distribute leadership and engage diverse views to promote creativity. Borrowing concepts from other fields will not solve all our problems, but it will broaden our range of options. 🌶

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Reference

Game ET, E Meijaard, D Sheil & E McDonald-Madden (2013). Conservation in a wicked complex world; challenges and solutions. *Conservation Letters* DOI: 10.1111/conl.12050.

Table 1: Lessons for conservation science from the world of complex science

Current conservation practice	Change suggested for complex systems & wicked problems
Emphasis on "best practice" in conservation approaches	Challenge "best practice"
	Responsive to competing and creative solutions
	Clearly established objectives beneath which there is flexibility in how tasks are achieved
Desire to be evidence based	Focus analysis of evidence on the search for pattern recurrence
Heavy reliance on experts and a narrow view of expertise	Reduce emphasis on "expert" opinion in favor of a more diverse set of voices and a broader view of expertise
Over reliance on feedback control or passive adaptive management as a response to complexity	Emphasis on predicting the likely impact and benefit of strategies in the context of multiple scenarios
Belief that clear measures of success and/or failure exist	Honesty about the trade-offs in any outcome
Reluctance to share information on perceived failures	Communicate transparently and constructively about perceived failures and uncomfortable truths
	Failure of a campaign or strategy is an acknowledged risk of doing business
Hierarchical leadership	Distributed responsibility for decision making
Focus on strategy or means rather than ends	Clear articulation of the outcomes we are ultimately trying to achieve

Two (online) birds in the hand

Citizen scientists flock to Eremaea eBird

By Richard Fuller, Hugh Possingham, Mat Gilfedder and Ayesha Tulloch

It is a sad but true fact that several of the NERP-ED and CEED Chief Investigators have a pathological love of birds. One of the associated afflictions of this appears to be a love of data about birds – lists of birds, counts of birds, graphs of counts of birds, lists of lists of birds... You get the idea. Hence it was only logical that we have entered into a partnership with the fastest growing and most exciting citizen science endeavour in Australia – Eremaea eBird.

Eremaea Birds is an online bird atlasing system. It was launched back in 2003 by Australian birders Richard and Margaret Alcorn and, at the time, it was the world's first such system. The word 'Eremaea' comes from the name of the Australia's great central desert bioregion.

Eremaea Birds enabled birdwatchers, for the first time, to enter lists of birds they had seen anywhere around the world. This was heaven for many Australian birdwatchers and ten years later there were thousands of regular Eremaea users and over 3.8 million records.

Bird nuts in action at Oxley Creek Commons in Brisbane's outer suburbs (the 'nut' in the broad-brimmed hat is Hugh Possingham). Birdwatchers have been listing birds in this location over many years. Eremaea eBird will now make the fruits of these efforts available to everyone at the touch of a button.

Eremaea was founded on the principle that bird data should be freely shared (something that is dear to the heart of the Environmental Decisions Group) and fundamental for transparent environmental decision making.

In parallel with this exciting Australian initiative, eBird was launched in North America in 2002 by the Cornell Lab of Ornithology and the National Audubon Society. It went global in 2010. eBird's vision, similar to that of Eremaea, is to allow birdwatchers to submit geographically tagged lists of bird observations and to make all data freely available. eBird had a small team of local Australian reviewers, and has had around 1000 observers contributing records in Australia.

How do I get started?

Eremaea eBird is simple to use. A birdwatcher simply enters when, where, and how they went birding, then fills out a checklist of all birds seen and heard at the visited sites. This can be done live in the field via a smart phone app (BirdLog), or when back at the desk after a birding trip.

eBird provides various options for data gathering including point counts, transects, and area searches. If no-one has previously visited the location at which you are birdwatching, you can easily create a new one via an interactive map. Automated data quality filters developed by regional bird experts check all submissions before they enter the database.

Local experts then personally review unusual records that are flagged by the filters, contacting observers to verify details. If you see something unusual, it is a great idea to write field notes on the spot, and obtain a photograph if possible.

Eremaea eBird encourages users to participate by providing tools that maintain personal bird records and enable users to visualize data with interactive maps, graphs, and bar charts. All these features are available in English, Spanish, and French.

So there's no excuse – spend an hour in your back yard or visit your local park today and instantly tell the world about the birds you see!

http://ebird.org/content/australia/

The powerful owl, red-backed fairy wren and bush stone-curlew; three favourites seen here and there around Brisbane by the cognoscenti (people in the know). Now, thanks to Eremaea eBird, the sharing of information on 'what bird is found where' is there for everyone to see. (The owl and the curlew photos are courtesy of Mat Gilfedder, the fairy wren is courtesy of Richard Fuller.)

> "This beautiful partnership brings together a huge band of active citizen-science birdwatchers, and secures the long term future for free bird data here in Australia."

With such a similar shared vision it made sense to combine efforts, and so eBird has teamed up with Eremaea and the ARC Centre of Excellence for Environmental Decisions to launch the new Eremaea-eBird portal. This beautiful partnership brings together a huge band of active citizen-science birdwatchers, and secures the long term future for free bird data here in Australia.

Eremaea eBird also provides major new opportunities for understanding the distribution and abundance of birds across our continent, and advancing their conservation. Data are rigorously checked for quality, and continually open to public scrutiny and improvement owing to the open access model.

Eremaea eBird data are automatically shared with BirdLife Australia's Atlas programme, as well as online biodiversity data portals including the Atlas of Living Australia and the Global Biodiversity Information Facility.

EDG researchers are not only contributing to stories on the web page http://ebird.org/content/australia, but we look forward to combining this growing data source with BirdLife Australia's Atlas data to solve conservation problems in Australia. Ongoing projects include: understanding changes in urban bird communities, building an Australian Bird Index, monitoring threatened species and understanding bird invasions. 🔴

More info: Richard Fuller r.fuller@uq.edu.au

Richard Fuller, Hugh Possingham and Ayesha Tulloch are researchers with the Environmental Decisions Group. Mat Gilfedder is a keen nature photographer (see his photos at http://pbase.com/gilfedder) and all four have been involved in the establishment of Eremaea eBird. Needless to say, all four are also bird tragics.
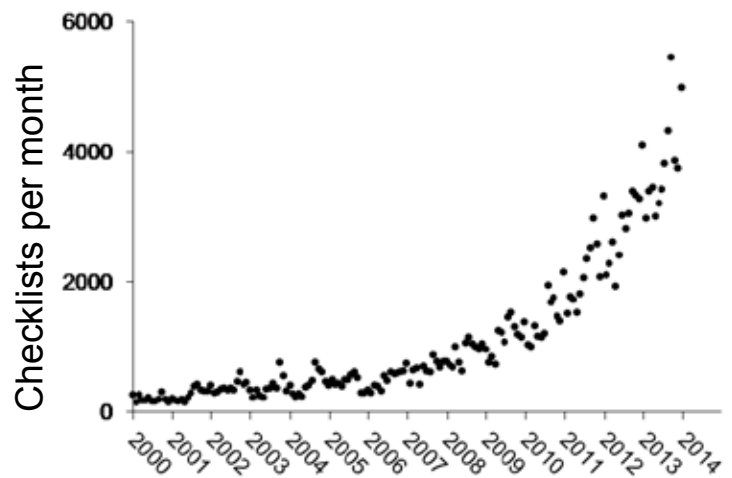
An explosion of lists: Submissions to Eremaea eBird are growing rapidly with more than 7000 checklists currently being submitted per month. Just two weeks since it went live on 1 Feb 2014, there were more than 57,000 pageviews, 761 unique visitors, and of the almost 7000 visits to Eremaea eBird in the first two weeks, more than 22% were first time visits. These visits have predominantly come from Australia, but the site is already being visited from 45 other countries around the world.

How reliable is volunteer-collected data?

In *Decision Point #64*, Judit Szabo and Hugh Possingham wrote a story that compared volunteer-collected bird data with scientist collected data. To their surprise, the results were surprisingly close – and the small differences that were detected were readily explained. Which just underscores the potential value of citizen science in the conservation of our avi fauna.

Getting more bird for your buck

Cost-effectiveness is all about how you frame the question

By Dean Ansell (ANU)

Drive out into the rural landscape and you'll see a variety of plantings of native vegetation. They'll consist of different species, be of different shapes and sizes, and placed in different parts of the landscape. Indeed, about the only thing they have in common is that they all cost a lot to establish in terms of time and money.

Resources for ecological restoration are limited, regardless of whether the money is coming from the government or being privately funded. So, how do you get the best return for your limited restoration dollar? The answer depends on the type of returns you're looking for. Appropriately framing your costs and benefits is critical to any evaluation you might undertake. To illustrate this, consider three common restoration activities commonly practiced in agricultural landscapes.

The first is a linear revegetation site or planting, commonly known as a shelter belt or tree line. The second is a block-shaped planting. Contrasting these two activities which involve planting of vegetation, our third example is a patch of remnant woodland that has been fenced to exclude grazing in order to protect and enhance its natural values. For the purposes of this 'thought experiment', we'll assume each project is the same size (1.5 hectares), is being done in the same region, and has been established for 10 years. Of course, the patch of remnant vegetation is much older than ten years but in this case we assume the fence was erected 10 years ago.

The following set of numbers are all illustrative for comparison purposes (as opposed to exact numbers relating to any specific situation). In reality, there are many costs, both public and private, associated with the establishment of a restoration project. Here we focus on the basic establishment costs. Where possible, I have tried to use realistic cost estimates.

Basic costs and opportunities lost

Costs associated with the revegetation projects (linear planting and block planting) include equipment, materials and labour for direct-seeding, as well as fencing materials. The remnant patch, by comparison, only involves a fencing cost. So, if we plug in some broadly representative costs we might get something like Table 1.

If we work out the total cost of restoration actions converted to present value (compounded at 5% per annum over 10 years), and determine a per hectare cost, we can see that the remnant protection project is the cheapest. This is perhaps not surprising given the absence of planting costs with this project. Between our two revegetation sites, note the greater cost per hectare of the linear revegetation project, despite being the same size as the block-shaped planting. This is a result of the cost of fencing and the higher perimeter-to-area ratio of the linear planting. (In many situations the planting is up against an existing fence line cutting this cost in half.)

So, on basic costs, remnant protection comes out as the cheapest restoration activity. However, as these activities are taking place in 'production' landscapes, decision makers (which in these situations usually means land owners) need to also consider the opportunity cost

of their choices; that is the value or profit from alternative use of that land. In this case, dedicating each of the sites to restoration means that they can no longer generate income from agriculture if we assume no future grazing or alternative income-generating activities.

We now calculate the total cost of our restoration factoring in opportunity cost of lost income from grazing using typical stocking rates and gross margins over the 10 year period (Table 2), with a lower opportunity cost associated with remnant protection reflecting the lower productivity of those sites for graziers. We can see that while our protected remnant remains the cheapest project per unit area, its total cost has risen substantially as a result of the incorporation of opportunity costs (as has that of the block revegetation site). Indeed, the linear planting is now roughly the same as the remnant protection. This is a result of the low opportunity costs associated with linear plantings, which are typically located along fence lines where agricultural production is marginal. It's one of the key reasons why this shape of planting is overwhelmingly the most common found in agricultural landscapes.

Table 2: Establishment & opportunity costs of three restoration activities.

	Linear planting	Block planting	Remnant protection
Total establish. cost	$3820	$2910	$1960
Opport. cost (per annum)	negligible	$330 ($220 per ha)	$231 ($154 per ha)
Total restor cost (after ten years)	**$6222 ($4148 per ha)**	**$8891 ($5927 per ha)**	**$6098 ($4065 per ha)**

These are our estimated (back of the envelope) costs of restoration. Let's now consider the effectiveness of each project.

Comparing benefits

Assume that our restoration objective is to increase the richness of bird species (the number of species) and we conduct a series of bird surveys at each site. We discover that the greatest richness occurs at the woodland remnant, followed by the block planting and then the linear planting. The woodland represents a more established and structurally complex habitat, and we might expect greater richness in the block planting (as compared to the shelter belt) where you might find more edge-sensitive bird species that don't use the linear planting.

Table 3: Benefit-cost ratios of three restoration activities.

	Linear planting	Block planting	Remnant protection
Benefit (bird spp)	12	18	22
Total restor. cost	$4148 per ha	$5927 per ha	$4065 per ha
Benefit-cost ratio	0.003	0.003	0.005

> **"The answer depends on the type of returns you're looking for. Appropriately framing your costs and benefits is critical to any evaluation you might undertake."**

Table 1: Establishment costs of three restoration activities.

	Linear planting	Block planting	Remnant protection
Fencing	$2870	$1960	$1960
Site prep	$250	$250	$0
Direct seeding	$700	$700	$0
Establishment cost	$3820	$2910	$1960
Total establish cost (after ten years)	**$6222 ($4148 per ha)**	**$4740 ($3160 per ha)**	**$3193 ($2128 per ha)**

Three different types of restoration activities commonly practiced in agricultural landscapes: linear plantings (left), block plantings (centre) and fencing off remnant vegetation. Which activity is most cost-effective?

To determine the cost-effectiveness of the three projects, we divide the measure of effectiveness, in this case bird species richness, by the cost to provide a benefit-cost ratio (BCR) – a measure of the conservation benefit per dollar, where the higher the number the greater the cost-effectiveness (see *Decision Point #75*). When we calculate BCRs we find that the fenced remnant project is most cost-effective, followed by the block revegetation and the linear revegetation sites (Table 3).

Real benefit = conservation gain

While this seems intuitive, calculating the benefit-cost ratio in this way hasn't really told us what the return is on our restoration investment. Remnant patches often have more bird species in them. Finding that there are more birds in them after fencing them off doesn't mean the cost of fencing has delivered us the best conservation return.

By comparing the total richness at each site we are only comparing the overall conservation value of each site, not measuring the effect that our restoration actions have had. In this case we concluded that protecting woodland remnant is the most cost-effective because it has the highest species richness and is also the cheapest (per unit area). However we are starting from a much higher base or condition, presumably with a number of species already present before restoration, when compared to a bare paddock where our plantings were undertaken.

A more appropriate measure of cost-effectiveness requires measurement of the conservation gain; that is the increase in bird species richness that has resulted from our restoration action. We can do this by measuring the change in the bird community before and after restoration, or match each restoration site with a control site that reflects the pre-restoration condition. In the case of our two planting sites this would be a cleared paddock, whereas the control for our fenced woodland remnant would be an unfenced (eg, grazed) remnant of the same vegetation type.

Let's now imagine that we have collected data from our restoration sites as well as paired control sites, and we use the difference (Δ) in species richness between the pairs (ie, the conservation gain) as our measure of effectiveness (Table 4). Recalculating BCRs for the three projects reveals that our block planting is the most effective, with the greatest increase in species richness, and is also the most cost-effective, despite being the most expensive per unit area.

Of course, this is a 'simplistic' thought experiment. In reality, when we consider the conservation of bird species, then a combination of strategies might be best. However, it serves to illustrate how important framing our costs and benefits can be to how we decide where to invest our limited resources. If you were to only factor in upfront costs (and ignore opportunity costs) and benefits that ignore conservation gain (or loss) it's likely your choices on what's cost-effective would be misplaced. ◙

More info: Dean Ansell dean.ansell@anu.edu.au

Dean is a PhD student at ANU. He is studying the effectiveness and efficiency of woodland bird conservation in agricultural landscapes and looking at many block plantings, shelter belts and efforts to protect remnant vegetation.

Table 4: Benefit-cost ratios of three ecological restoration activities.

	Linear planting	**Block planting**	**Remnant protection**
Benefit (Δ bird spp)	9	17	4
Total restor. cost	$4148 per ha	$5927 per ha	$4065 per ha
Benefit cost ratio	0.002	0.003	0.001

Real benefits

Even in this simple 'thought experiment' of three treatments it's clear that measuring the real benefit of a restoration effort can be tricky, and yet it's critical to get right to be able to measure cost effectiveness. Here are three *Decision Point* resources to help you get a handle on this thing called benefit:

Where would you put your conservation dollar?

Phil Gibbons invites you to try his quick quiz in which you choose between restoration options in order to maximise the biodiversity benefit. This simple exercise helps you focus on conservation gain.

"I think most people would have intuitively prioritised land that was in the best condition but when it comes to maximising your return on conservation investment the 'wisest' choice may not be the obvious choice."

Decision Point #30

Measuring the effects of conservation management

Mick McCarthy asks what would have happened if it hadn't happened? The 'it' here is the restoration activity.

"Determining what would have happened in the absence of management will often be difficult. The best way to do this is to not only monitor the areas that are managed, but also to monitor some analogous areas that are not managed."

Decision Point #64

When ranking environmental projects

David Pannell has spent much of his career developing systems to help managers and decision makers rank environmental projects by analysing their cost-effectiveness. Last year he distilled his wealth of experience into a twenty part blog series (simply titled Ranking Environmental Projects). You can read the key points of this series in *Decision Point #75* (with a link to a single document that brings it all together).

Taking resilience back to its ecological roots

A CEED NERP workshop
(Rottnest Island, December 2013)

By Rachel Standish (UWA), Nancy Shackelford (Victoria University, Canada) and Jane Catford (Uni of Melb)

Resilience is a foundational concept of ecology and, more recently, has become central to conceiving how ecosystems might cope—or not—with environmental change. Despite its potential importance to decisions for conservation and environmental management, confusion about how to define and measure resilience has impeded its application to decision making.

Resilience was first introduced to the ecological literature with a clear and concise definition: the capacity of an ecosystem to absorb change and disturbance, and still maintain the same relationships between populations or ecosystem variables. By this definition, resilience informs ecosystem management because it helps to predict the rate and extent of ecosystem recovery after disturbance. The aim of our workshop was to assemble experimental data to compare the extent and speed of recovery from disturbance across different ecosystems and types of disturbances. In doing so, we intend to learn more about resilience and improve its practical application to ecosystem management.

We identified 20 community ecologists with experimental data describing the recovery of ecosystems to disturbance, and invited them to our workshop at Rottnest Island in December 2013. Ecologists came from Sweden, Japan, North America, Canada and Australia with datasets from boreal forest, Mongolian rangelands, grasslands, coral reefs and temperate streams to name a few. Plant

Gunning for resilience at Rottnest Island: (from right to left) are Brandon Bestelmeyer (New Mexico State Uni, New Mexico), Andrew Denham (Office of Environment & Heritage, NSW), Jane Catford (Uni of Melb), Jodi Price (UWA), John Dwyer (Uni of Qld), James Gilmour (AIMS, Western Australia), Takehiro Sasaki (Uni of Tokyo, Japan), Natasha Banning (UWA), Brian Starzomski (Uni of Victoria, Canada), Chuck Price (UWA), Rachel Standish (UWA), Nancy Shackelford (Uni of Victoria, Canada), Lauren Hallett (Uni of California Berkeley, USA), Loretta Battaglia (Southern Illinois University, USA), Richard Hobbs (UWA) and Mats Dynesius, (Umea University, Sweden). (Photographer and workshop assistant: Mandy Trueman, UWA).

> **"**The aim of our workshop was to assemble experimental data to compare the extent and speed of recovery from disturbance across different ecosystems and types of disturbances.**"**

Brandon, Natasha, Takehiro, Richard and Lauren discuss explanatory variables on the second day of the workshop. (Photo by Mandy Trueman).

communities are well represented among the datasets but we also have data describing the recovery of communities of liverworts, soil microbes, kelp and fishes to disturbances that range from fire, drought, mining, livestock grazing and hurricanes.

The first day of the workshop was devoted to a brief discussion of concepts and to familiarizing people with the datasets (and, importantly, the wonders of Rottnest Island—namely beaches, bikes, beers and quokkas). The second day of the workshop was split between a discussion of options for response and explanatory variables and, critically, how to make these comparable across the different ecosystems and disturbance types for use in a meta-analysis.

As a group, we agreed on a response variable to use in the first instance based on the Bray-Curtis index of similarity between communities before and after disturbance. Discussions regarding explanatory variables are ongoing; the final variables are likely to include metrics describing the nature of the disturbance, connectivity and the relative importance of abiotic and biotic filters to community recovery. Having made solid progress by the end of day two, the group broke for a cycle around the island followed by a meal at the local pub.

The final day of the workshop was devoted to an overview of progress on the main project and to discussion of ideas for additional projects. Analysis for the main project is underway with the aim of preparing a manuscript by mid-2014. Additional projects include an exploration of the link between biotic and abiotic recovery, the contribution of species richness to resilience and the contribution of scaling theory to the measurement of resilience. We extend our thanks to the participants for actively engaging in the aims of the workshop and helping to make our first workshop a success.

More info: Rachel Standish rachel.standish@uwa.edu.au

Urban Biodiversity

A CEED/NERP workshop (Bungendore, October 2013)

By Georgia Garrard (RMIT)

Our urban environments present unique challenges for biodiversity conservation. Tradeoffs between competing objectives are complex and vested interests high. Past planning decisions often leave lasting ecological and social legacies. Despite decades of research, key knowledge gaps remain around the processes that drive patterns of biodiversity and how they interact with social systems. Novel and sophisticated approaches are required to conserve biodiversity in urban systems.

In late 2013, representatives from NERP ED, CEED and the Department of the Environment took part in a workshop on urban biodiversity conservation and management. The workshop aimed to identify key objectives for urban biodiversity conservation in Australia, and investigate the role of decision science and new research approaches in this area.

Researchers considered questions such as: What are key research questions for urban biodiversity in Australia now and in the future? How do we make decisions about conservation actions in highly modified landscapes? What are appropriate objectives for urban biodiversity, and how can we measure conservation success in cities? Do current policies reflect these objectives?

The workshop was extremely productive and enjoyable – an amazing number of new ideas and research questions were raised and investigated, and the staff at the Carrington Inn in Bungendore (NSW) looked after us very well. Several papers are in the pipeline, so watch this space!!

More info: Georgia Garrard georgia.garrard@rmit.edu.au

> **"**Tradeoffs between competing objectives are complex and vested interests high.**"**

Participants of the Urban Biodiversity workshop: (standing from the left) Richard Fuller (UQ), Mat Wolnicki (DoE), Sarah Bekessy (RMIT), Pia Lentini (UniMelb), Dave Kendal (ARCUE), Ross Rowe (DoE), Karen Ikin (ANU), Laura Mumaw (RMIT), Chris Ives (RMIT), (sitting) Danielle Shanahan (UQ), Caragh Threlfall (UniMelb), Georgia Garrard (RMIT) and Laura Rayner (ANU).

Dbytes

Dbytes is EDG's internal eNewsletter. It gets sent to members and associates of EDG each week, and consists of small snippets of information relating to environmental decision making. They might be government documents, research articles, blogs or reports from other research groups. Here are six bytes from recent issues. If you would like to receive the *Dbytes* eNewsletter, email David.Salt@anu.edu.au

1. A sustainable supply of farmland

Between 1961 and 2007, cropland expanded by 11 per cent, a trend that continues to grow. This report, entitled Assessing Global Land Use: Balancing Consumption with Sustainable Supply, was produced by the International Resource Panel: a consortium of 27 internationally renowned resource scientists, 33 national governments and other groups, hosted by UNEP.

http://www.unep.org/newscentre/Default.aspx?DocumentID=2758&ArticleID=10697&l=en

2. Biodiversity and Environmental Change

This data-rich book demonstrates the value of existing national long-term ecological research in Australia for monitoring environmental change and biodiversity. Long-term ecological data are critical for informing trends in biodiversity and environmental change. The Terrestrial Ecosystem Research Network (TERN) is a major initiative of the Australian Government and one of its key areas of investment is to provide funding for a network of long-term ecological research plots around Australia (LTERN). LTERN researchers and other authors in this book have maintained monitoring sites, often for one or more decades, in an array of different ecosystems across the Australian continent. The book's editors are David Lindenmayer, Emma Burns, Nicole Thurgate and Andrew Lowe.

http://www.publish.csiro.au/nid/21/pid/7009.htm

3. Protected Areas database online

Did you know the smallest protected area in Australia is only five square metres? It's Waubadebars Grave Historic Site in Tasmania. The largest terrestrial reserve is the Southern Tanami Indigenous Protected Area at over 10.1 million hectares. This information and other maps, spatial data and statistics on Australia's protected places can be found on the Collaborative Australian Protected Areas Database (CAPAD 2012)

http://www.environment.gov.au/topics/land/nrs/science-maps-and-data/capad

4. New MOOC on Tropical Coastal Ecosystems

The University of Queensland has opened a free on-line course (1st/2nd year University level) on Tropical Coastal Ecosystems and Global Change as part of the edX partnership with Harvard and MIT. This exciting course will introduce the major tropical coastal ecosystems (principally coral reefs, mangroves, sea grass meadows) and will explore the problems and solutions they face.

https://www.edx.org/course/uqx/uqx-tropic101x-tropical-coastal-1442

5. Perspectives on the WA Shark Frenzy

A Conversation Editorial by Carlos Duarte. The issue of shark attacks has gained the momentum of a runaway train. Every single statement in support of his policy by the Premier and every single rally by the opposed activists adds fuel to the train, which now seems unstoppable.

Editor's note: This is the best editorial I've seen on the 'shark cull' issue, one of many excellent commentaries on this topic being run at the Conversation (which has 36 stories in this area, see http://theconversation.com/topics/sharks)

...a needle in a haystack

As anyone involved in field monitoring will tell you, detecting wildlife is always a challenge. Try standing on a shaky canoe travelling along narrow channels in a wetland, peeking through very dense marsh vegetation with all your senses focused on searching for a small species of lemur! That was the daily routine for Gurutzeta Guillera-Arroita (pictured standing here) and José Lahoz-Monfort in Madagascar. They were field-testing occupancy surveys for the Alaotran gentle lemur, a critically endangered species only found in one single wetland. (Luckily, the many hours of fieldwork resulted in only one capsized canoe, an event that was quickly nicknamed "the Malagasy Titanic" by the locals.)

Despite the careful searches, the lemurs were frequently missed at sites where they were known to be present. Imperfect detection has important implications for the modeling of species' distributions, as explained by Gurutzeta and José in their article in pages 6-7. Collecting data in ways that allow detectability to be estimated is an important step to reliably modeling the habitat preferences of species. (Photo by J. Lahoz-Monfort)

What's the point?

Aussies engaging with conservation

Do Australians have much engagement with conservation? According to the Australian Bureau of Statistics, yes we do. The ABS recently released its survey on Community Engagement with Nature Conservation (2011-12). It found that in 2011-12, nearly three quarters of Australian adults (73%) took part in some activity that involved contact with nature in the last 12 months. For most that simply amounted to a visit to a national park. However, some went a bit further with an estimated 8.1 million Australian adults (47%) having participated in nature conservation activities at home or on the farm in the last 12 months. Forty-three percent had planted or cared for Australian native trees or plants, and almost one in five (19%) had cared for Australian native wildlife. Nearly half a

million Australian adults (484,000) had participated in voluntary work to conserve nature for a nature conservation organisation. Unfortunately, most weren't willing to do more. When Australian adults were asked to indicate whether they could be encouraged to become involved or more involved in nature conservation activities, nearly three quarters of them indicated they could not be. 🍎

Community Engagement with Nature Conservation (2011-12)

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.
The funding of the research presented in this issue of *Decision Point*, like most research, comes from multiple sources and is identified in the original papers on which the stories are based (references are provided in each story). In terms of CEED and NERP ED, the research on offsetting coastal development (p4,5) was supported by CEED; the work on imperfect detection (p6,7) was supported by CEED and NERP; the analysis of SMART targets (p8) was supported by NERP; the examination of conservation in a complex world (p9) was supported by CEED, and the online bird atlas discussed on page 10,11 was supported by CEED.

To contact the EDG please visit our websites at:
http://ceed.edu.au/ or http://www.nerpdecisions.edu.au/