Taking spatial conservation to new depths
Prioritisation in 3D

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Decision Point is the free bimonthly magazine of the ARC Centre of Excellence for Environmental Decisions (CEED). CEED 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 and RMIT University.

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Our cover: The ocean realm is a three dimensional space. Conservation planning is more efficient when features and threats can be stratified with depth. Find out how on page 6. (Photo by Thomas Vignaud)

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On the point

CEEDlings to the world

It can make you sad. You see these bright-eyed, bushy-tailed young PhD students and post docs coming into the CEED network full of vitality and vigour, eager to save the world with their science (but sometimes a tad naïve about how the real world works); and before you know it they’re gone. They’ve completed their thesis or finished their research fellowship and they’re off to their next posting, often on the other side of the globe.

We saw them develop, earn their research stripes, struggle with the various challenges that beset every research project, and (mostly) triumph. And then, they move on in search of new challenges – a little bit wiser, tougher, less innocent and more mature.

It’s the natural course of life. The sadness of their leaving, felt by every parent watching their children grow and leave, is offset however by the knowledge that our little CEEDlings are (and will be) making important differences wherever they take root.

Indeed, CEED (and its associated networks) has now seen many early-career researchers come and go, and while we miss them all, it’s a beautiful thing to see them flourishing in foreign pastures; bringing new insights and approaches to the complex world of conservation science. You can read some of their stories in this issue (pages 18 and 19) and coming issues. And we have celebrated our clever Alumni in this year’s CEED Annual Report (see page 3).

CEED’s impact increases with time (see Figure 1 on page 3) and a big part of our future impact, that will likely never properly be evaluated because it’s so difficult to measure, will be the interactions of our Alumni as they develop into seasoned researchers. They still keep in contact with CEED (through Decision Point and Dbytes among other things) but they also keep in touch with each other through formal conservation science associations and informal social media networks.

Our CEEDlings began their academic careers with the fervent belief their science could make a real difference. As Alumni, they still strive to do so; and as they progress they all have half an eye on their sibling CEEDlings. Long may they flourish.

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CEED has a fantastic record of cutting-edge research and publication, and this work will have enduring impact. However, one our greatest legacies will be our people, and in particular our postgraduate students and post-doctoral fellows – our Alumni.

Our well-connected network of Alumni (self-identified as CEEDlings) now spans the globe, and is making an enormous contribution to improved environmental decision-making and biodiversity conservation in a variety of ways. If you want to see examples, now you can read their stories. We are profiling a selection of Alumni stories in this and future issues of Decision Point (see pages 18 & 19).

They are also featured in our brand new (2017) Annual Report. And, because we want all readers of this year’s Annual Report to take notice of our Alumni, these stories aren’t buried away in the appendices at the back. No, we’ve gone for the big splash approach and featured our Alumni network across a glorious full-colour, fold-out gatefold. You can’t miss it, because we want the world to notice these people and their stories.

The gatefold also contains some of the preliminary findings of our impact-evaluation exercise (another piece of CEED work we don’t want people to miss). The evaluation of CEED’s impact is still a work in progress (see Decision Point #102), but our findings so far suggest CEED has a strong story to tell. But it’s not just our story that’s important here. Our development and trialing of an approach to evaluate a Centre of Excellence will be yet another legacy of the Australian government’s investment in the Centre-of-Excellence program; a program like none other in the world, and the foundation of Australia’s academic leadership in the biological sciences.

Our approach to the impact analysis has been to evaluate the social and environmental impacts occurring from the interdisciplinary research produced by members, partners and associates of CEED. A set of criteria was developed to measure the initial impact of affecting change, such as the extent to which the research attributed to a change in policy, an improvement in decision making processes or an improvement in management practices.

The amount of collaboration, engagement and knowledge transfer activities were also considered. Traditional academic metrics were also analysed to provide a supportive context to the claims of impact, and we are benchmarking CEED against other similar Centres and networks.

The findings so far reveal that CEED has achieved a very high level of academic impact and currently has a growing influence on public policy and management practices. We can see from our analysis the time lag often reported between results from research being made available to the contribution to a policy change. Figure 1 demonstrates that the projects commencing at the inception of CEED have achieved far greater impact than those recently commenced.

In a sense, this also applies to our Alumni. As they mature into seasoned researchers, their impact will continue to grow. For they are really the seeds of CEED.

Figure 1: CEED research projects were ranked on impact. (*Nine projects that started before 2011 under other funding sources.) This figure appears in the gatefold of the new CEED 2017 Annual Report. The gatefold and cover are pictured below. If you'd like to download your own copy of the Annual Report, please visit our website.
Making big predictions using small data
Managing threats to communities of declining species with incomplete information

By Ayesha Tulloch (ANU and the University of Queensland)

We know little about how ecological communities respond to the management of the multitude of threats impacting them. And that’s despite decades of studying species’ responses to environmental change and, more recently, the threatening processes that destroy their populations and habitats. Our lack of knowledge is driven partly by a failure to adequately monitor our management of impacts. However, more generally, it reflects our inability to collect enough information across space and time to build good predictions.

I recently went through my own research to prove this point. In 2016 I participated in three studies evaluating the effects of management on species in Australia. One was only able to predict the likely outcomes of protection mechanisms for less than 60% of nomadic Australian birds. Another study only predicted fire management outcomes for a mere 12% of Banksia species in south-western Australia. And the third managed to predict likely responses to threat management for 42% of woodland birds in the endangered Box-gum Grassy Woodlands of eastern Australia.

We are slowly learning the effects of some management actions on certain well-studied species. For example, in grazing or cropping landscapes where trees have been cleared, a number of woodland bird species such as the willie wagtail, grey fantail and many honeyeaters will most likely increase in a patch of remnant vegetation if we restore tree cover through revegetation or grazing exclusion. We also know that other species might decline if their patch of vegetation is changed through restoration, because they prefer the current open conditions to more closed canopy woodland (eg, the much-loved Australian magpie, and parrots such as the eastern rosella). However, for many species, we have no idea whether conservation actions, such as planting more trees, will cause an increase or a decrease in their population as they are poorly studied or hard to detect. Waiting for more information to be collected hampers our attempts to stop species declines and could even result in species’ extinctions if management is too late (or wrong).

We want to recover communities of declining species, but how can we do this if we don’t know which species will benefit from which management action? The answer is superficially simple:

**Key messages:**

- By combining models of responses to threats with network analyses of species co-occurrence, we developed an approach to predict how an ecological community restructures under threat management.
- Information from a few species on co-occurrence and expected responses to alternative threat management actions can be used to train a response model for an entire community.
- This means incomplete data can still usefully inform our decisions around threat management.

Figure 1: A hypothetical species co-occurrence network representing shared environmental requirements of species K1 and U1 in pine forest patches and species K2 and U2 in woodland patches. K species have a known response to management, whereas U species have no information on likely outcomes of threat management.

Filling the gap

Our solution to filling the knowledge gap is that we should predict responses to management of ‘unknown’ species by using partial data and coexistence theory. We hypothesised that species who co-occur in the presence of threatening processes would share a similar response to the mitigation or elimination of those threats, as niche differences allow them to partition resources and maintain co-occurrence in the recovering landscape. Species that avoid one another in the threatened landscape are more likely to respond differently to threat elimination as their resource requirements (and hence threats) probably differ.

After threat management, our prediction was that species that co-occurred with a ‘lost’ species in a threatened landscape were more likely to be lost (due to shared resources or environmental requirements being lost), and that species that co-occur with ‘recovering’ species are more likely to recover (due to shared resources being restored). Using this information, we linked known responses to management by some common well-
studied species (eg, the willie wagtail) to unknown responses by rare or hard-to-find species who were able to survive with the known species (eg, the brown treecreeper, a listed threatened species in NSW).

From species to communities
Our study developed the first way of predicting management responses for an entire community of species living together in landscapes where multiple threats act in concert (Tulloch et al, 2018). Our approach enables managers to discover which species will benefit or decline under a selected management strategy, and how the entire community of linked species will change if one or more recovery actions are carried out in a degraded landscape.

We predicted the likely responses to threat management of all 88 bird species persisting in remnant patches of Grassy Box woodland of south-eastern Australia. This endangered ecosystem is being impacted by globally important threats of habitat loss, competitive displacement of woodland birds (by the overabundant noisy miner) and intensive livestock grazing. The innovative approach we developed combines dynamic models of species' responses to independent and combined threat management actions with network analyses revealing species' contributions to their co-occurrence network.

Our approach required two sets of information: models predicting the expected change in a species' colonisation of patches if one or more threats were reduced, and information on how that species shared existing space with other species. ‘Shared space’ was estimated using a method called co-occurrence analysis. This calculates the likelihood that two species will be found in the same patches.

Making more of partial information
Co-occurrence analysis relies on basic information on the presence or absence of each species in every patch, and therefore can be estimated for most species in a landscape. Models of species responses to management, however, generally require surveys repeated over temporal or spatial gradients of change in a level of a threat, and require a certain level of species detection to ensure a good model can be produced that relates the species’ occupancy of the landscape to variation in the threat. This is really hard to achieve for most species, and we were lucky to be able to produce models for 37 of the 88 species detected in more than 1% of surveys. Thus, we used only partial information on the responses of 42% of the bird community to predict change in 100% of the species under alternative management actions of either reduced livestock grazing, improved tree cover or reduction in an overabundant native competitor, the noisy miner.

We were fortunate to have the opportunity to evaluate our predictions five years after management of the three threats to woodland birds; and what we found supported our models. We found that species’ responses to management differed depending on how they were connected with expected ‘increasers’ or ‘decreasers’. If the known species was predicted to increase under management, an ‘unknown’ species that co-occurred with the known species was also more likely to increase. Likewise, if the known species was predicted to decline under management, an ‘unknown’ species that co-occurred with the known species was more likely to decline.

Our paper shows that analyses of co-occurrence networks are crucial for informing decisions about threat management when there are uncertainties about which species might benefit (or suffer) from a given action and not enough time or money to learn about every individual species’ response. By thinking not only about individual species but about how they share space and resources with others, we can ensure that management actions are chosen that benefit the most vulnerable species, and avoid actions that might lead to unintended declines.

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Reference

(Below) We are really bad at predicting management outcomes for entire communities such as the endangered Box Gum Grassy Woodland pictured here. (Photo by Ayesha Tulloch)
Spatial conservation prioritisation is a method used to identify areas where conservation goals can be achieved efficiently. Traditionally this has meant the region being considered is subdivided into two-dimensional planning units. These planning units are then allocated to a given management regime based on what biodiversity it holds, what threats are affecting it, and on how much it would cost to manage these conservation features.

Two-dimensional planning units make sense in most situations because this type of exercise is usually done on a map overlay, like a map of a coastline with a range of coral reefs and other marine ecosystems along its length. And maps, and the way we usually perceive space, are basically two-dimensional. But what if the biodiversity we are seeking to protect (or the potential threats to this biodiversity) varies at different depths in any of these planning units? Where that’s the case, the traditional two-dimensional approach may not be enough.

Oceans are inherently three-dimensional spaces and effective and efficient planning in oceans should take this third dimension—depth—into account. The vertical heterogeneity of biodiversity and threats might create conditions in which protecting biodiversity at one depth might be compatible with other uses of the ocean at another depth. For example, protecting important ecosystems on the sea floor could be compatible with some types of pelagic fishing above. In such instances, vertical zoning of the water column might prove a cost-effective conservation strategy.

In a recent paper published in *Methods in Ecology and Evolution,* we proposed and tested a novel 3D spatial conservation prioritisation approach for the marine realm. We used Marxan as the conservation planning software. This approach allows planners to create both horizontal and vertical zoning of management actions while still following the core principles of systematic conservation planning. It enables planners to account for depth-related variability in biodiversity, human activities, threats to biodiversity, environmental conditions and the cost of conservation actions.

The key modification enabling this is the creation of 3D planning units, with x, y, and z dimensions (Fig 1). This means planning units can potentially share boundaries with other planning units that are next to them but also above or below. Given that Marxan attempts to minimize the boundary of the resulting network of selected planning units (see *Decision Point #62*), we can use the 3D adjacency of planning units to integrate the third dimension into Marxan. Moreover, having 3D planning units enabled us to stratify the water column into different layers, allowing planners to account for biodiversity, threats, and cost of conservation actions, at different depths.

It makes sense in theory but how does it work in practice? We tested our new approach using the entire Mediterranean Sea as a case study. This involved developing a conservation plan which involved choosing sites where at least 20% of the

**Key messages:**

- Conservation features often vary with depth in the ocean realm
- 3D systematic spatial conservation planning has the potential to deal with this variation
- We demonstrated that a 3D approach to conservation planning in the Mediterranean Sea has the potential to generate more efficient outcomes than the traditional 2D approach

**ABOVE:** The ocean realm is fundamentally a three-dimensional space. Conservation planning in such conditions is more efficient when features and threats can be stratified with depth. (Photo by Thomas Vignaud)
distribution (accounted for in cubic kilometres) of over 1000 conservation features was represented.

The results from our case study showed that it was possible to achieve configurations of chosen 3D planning units in which the targets for all the conservation features were achieved. More importantly, we demonstrated that through this new approach, in some areas of the ocean, not all the planning units available along the water column were selected for conservation.

The fact that only certain layers of the water column are selected, suggests that a 3D approach might prove more efficient (in terms of total cost and space protected) than a traditional 2D approach, as it would allow other uses at depths that are not a conservation priority. Indeed, this proved to be the case when we compared the total cost and volume of the resulting configuration of selected sites (as compared to the 2D approach).

Vertical zoning is already practiced as a management strategy. It is used in protected areas in Mexico, Canada, Australia and New Zealand. Our new 3D approach to spatial conservation planning could provide support in the planning on such protected areas.

This new approach to spatial conservation prioritisation opens the possibility of targeting specific threats to specific features of conservation interests at specific depths. As human intervention in the marine realm increases in both intensity and extent, tools such as this may prove critical for effective marine conservation planning and action.

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Reference

Figure 1. The concept of spatial conservation prioritisation in 2D and 3D in marine ecosystems. a) The traditional approach to marine spatial prioritisation, in which the planning region is subdivided into 2D planning units (x,y coordinates). b) The new 3D approach to marine spatial prioritisation, where planning units are defined as a three-dimensional space (x, y, z, coordinates), and are subdivided vertically (from Venegas-Li et al, 2017).

Figure 2. Example of total cost a) and volume b) of the resulting conservation area configuration for the 3D and 2D spatial conservation prioritisation approaches at different spatial compactness levels. ‘Optimal’ BLM values for the 3D and 2D approach were 0.05 and 0.007 respectively, shown as full red markers (from Venegas-Li et al, 2017).
Managing natural environments involves making difficult decisions about when to intervene to prevent undesirable changes. Intervening too early may result in unnecessary management actions, while intervening too late may lead to much greater costs or irreversible outcomes. ‘Decision triggers’ is one approach that can be useful to help link monitoring data with management decisions. Decision triggers represent a point or zone in the status of a monitored variable indicating when management intervention is required to address undesirable ecosystem changes (Figure 1).

In 2014, we brought together conservation managers and scientists from across Australia and New Zealand to share ideas and accelerate progress toward the development of decision triggers for protected area management (see Decision Point #81).

Our workshop formed the basis of three peer-review papers, where we: 1) explored the science behind decision triggers, and why conservation scientists are embracing the concept; 2) gathered perspectives from conservation practitioners on the current use and potential future application of decision triggers; and 3) developed guidance for conservation practitioners on the process and tools available to help integrate decision triggers into existing planning and management frameworks. Here are some key insights emerging from that work.

1: The science behind decision triggers

One strand of our research explored the science behind decision triggers and why they, and related concepts, are growing in favour within the scientific community (Cook et al, 2016).

Evidence-based management involves using the best available evidence to support decisions. Decision triggers fill a critical gap in operationalising evidence-based management, by linking monitoring data with a decision about when and how conservation managers should act if a system moves towards an undesirable state.

A variety of terms used in the scientific literature are analogous with the decision triggers concept (see Table 2 in Cook et al, 2016 for a full list of terms and definitions). The primary aim of decision triggers is to help decision-makers determine when to intervene in any managed system through a systematic, a priori consideration of the desired state of the system and the management interventions that can positively influence that state.

Setting a decision trigger requires an ecological attribute or threatening process (the target for management) to be monitored. The boundary between the zones defined as desirable and undesirable system states becomes the trigger point for action (Figure 1a). A more nuanced view of the system may identify multiple states (eg, desirable, acceptable, undesirable and unacceptable), with trigger points for different actions associated with each of the boundaries between these zones (Figure 1b).

The benefit of multiple states is that corrective actions can be tailored to potentially offer early intervention options that may be cheaper or less invasive, correcting the system before unacceptable changes occur. For example, a trigger point between desirable and acceptable states in the case of a threatened species may initiate more in situ conservation actions, such as reproduction support (eg, adding nest boxes), while crossing the boundary between undesirable and unacceptable may trigger the more extreme action of taking individuals from the wild for a captive breeding program.

Multiple trigger points also accommodate uncertainty as to the exact value that would be best.

Decision triggers can be informed by ecological thresholds when they exist and are understood. This can assist managers to prevent catastrophic shifts in ecosystems. However, decision triggers can also be designed to manage and counter processes that lead to more gradual and continuous degradation or a priori environmental targets (eg, those set in regulations), whereby the desired condition of the system is defined and triggers can be set to keep the system within a preferred ecological state.

The development and implementation of decision triggers should not be seen as a one-off process in which trigger points, and the possible management actions associated to them, are set and become fixed or immovable. Evidence-based management is an iterative process (eg, adaptive management...
Operational barriers:  
Scientific knowledge gaps:

Figure 2: The frequency of operational barriers and scientific knowledge gaps identified as impeding the adoption of a decision triggers by practitioners (see Addison et al. (2016) Table 2 for full details).

and structured decision-making, and decision triggers should be evaluated and adjusted over time as new information becomes available. This is critical because not only will our understanding of the system improve over time, but the responses of the system itself are also likely to be modified in response to environmental change.

Despite an increasing acceptance of the value of decision triggers, there is a need for greater understanding of the suite of methods that can assist in setting decision triggers and guidance on how to integrate triggers into the existing management approaches within organisations. Moving the concept of decision triggers forward requires the conservation community, both scientists and decision-makers, to work together to ensure decision triggers are as robust as possible but also able to be implemented within the realistic management contexts faced by management organisations.

2. Perspectives on decision triggers

How well do conservation practitioners support and use decision triggers? This was another element of our research and answering this question involved consultations with managers about their practice (Addison et al., 2016).

We found a wide range of organisational motivations for developing and using decision triggers. Many of these go well beyond a desire to prevent negative conservation outcomes. Other important motivations include: supporting decision-making by providing clarity about when and how to act; improving transparency of organizational decisions; removing the need for guess work; and guarding against the paralysing effects of uncertainty.

However, the results of our consultations suggest that the application of decision-triggers was ad hoc. Examples of where it had been applied related to specific systems, primarily where threats are well-understood or management issues are controversial. For example, managing significant threats to biodiversity from fire or invasive species management, setting quotas for harvesting or controlling native species, and determining when to remove threatened populations from the wild. While these examples are encouraging, they are also rare.

Practitioners shared their views on the operational barriers (issues within organisations) and scientific knowledge gaps (lack of knowledge or techniques) impeding the development and implementation of decision triggers. This revealed that most organisations are facing similar challenges (e.g., insufficient resources and the lack of a process and methods for developing decision triggers across different contexts), and this is hampering the routine use of decision triggers. Gaps in scientific understanding of how systems function were also seen as a major issue impeding the adoption of decision triggers (e.g., uncertainties around ecological processes, and a lack of targeted, robust and reliable baseline monitoring data; Figure 2).

Practitioners are keen to adopt decision triggers as part of routine management for a range of threats, species and ecosystems. However, integrating decision triggers into day-to-day management requires methods that can be widely applied. Practitioners were seeking support from the academic community to overcome the barriers they face. They were particularly interested in seeing an overarching process and supporting methods to develop decision triggers that would fit within existing management frameworks and allow for flexibility, such that decision triggers can be developed for different management contexts, rather than prescribing a one-size-fits-all approach.

3. Integrating decision triggers into management

The final strand in this research drew on the depth of existing management, evaluation and conservation planning frameworks to highlight how the development and implementation of decision triggers align with the critical stages of evidence-based decision-making (Figure 3; de Bie et al., 2017). Importantly, we identified where these steps fit within the existing frameworks used by management agencies. These frameworks are no doubt familiar to Decision Point readers: Adaptive Management, the Open Standards for Conservation Measures, Management Strategy Evaluation, Structured Decision-making, and Vital Signs Monitoring (see Table 1 in de Bie et al., 2017) for details). These commonly used frameworks all cover the critical stages for practitioners to integrate evidence into decision-making.

The development and effective integration of decision triggers relies on a robust process for the initial stages of decision-making, including (Step 1, Figure 3) setting the decision context and identifying objectives and indicators, and (Step 2) determining management actions. Decision triggers can be set using a number of methods, depending on the availability of scientific data and expertise, the number of objectives for management and the resources available.

One consideration in selecting the most appropriate methods is whether decision triggers are to be set for single or multi-objective decisions, and whether decision triggers will be set using value-based information and/or scientific evidence (Step 4; Figure 3). Within the diversity of approaches are options that can be used in data-rich situations (i.e., where there is a robust evidence base) as well as the more common data-poor situations.

Under single objective management contexts, where there is one objective for the system (e.g., an environmental objective...
that is managed and monitored, in the absence of any competing environmental, social, or economic objectives, statistical approaches are appropriate to develop decision triggers. For example, control charts, statistical thresholds, or thresholds of potential concern, can be used to determine the statistical bounds of natural variation to inform bounds of acceptable and unacceptable system states and associated trigger points for action.

Under contexts where there are multiple competing objectives (e.g., competing social, economic, political and/or environmental objectives) it may be more appropriate to use predictive methods to set trigger points, which explicitly deal with potential trade-offs among objectives. For example, optimisation modelling or multi-objective participatory modelling, can be used to formally trade-off competing objectives and assist with setting decision triggers.

Value-based approaches can be used in situations where social, economic and/or political factors are dominant. This is where decision triggers can be based entirely on values or preferences, reflected through a utility threshold or regulatory standard. These triggers will often represent arbitrary levels that make no reference to the ecology of the system, but instead represent socially unacceptable condition or the level of an indicator that regulators, decision-makers, or society wish to avoid or are mandated under legislative or management authorities. For example, the population density of a charismatic species that enable visitors a good chance of seeing the animal.

Advice for implementation

Our studies found that there is support from both scientists and practitioners for the use of decision triggers in the management of natural systems. However, setting meaningful decision triggers for management remains a daunting task.

For decision triggers to be effective there must be a commitment to ongoing monitoring of the relevant indicators. Monitoring should be targeted (i.e., using an indicator where the relationship with the system of interest is clearly defined), cost-effective and well-designed to generate the information needed to make decisions.

The use of decision triggers should be an adaptive process, with the iterative cycles of review commonly found in adaptive management frameworks (see Decision Point #102). As understanding of the system increases, it may be necessary to refine the conceptual model of system dynamics, the most appropriate indicator and the most appropriate management actions.

Next steps

The next step is to test a wide range of case studies to illustrate the application of decision triggers to real-world management problems, to provide a compendium of diverse contexts for conservation practitioners to learn from and build upon.

Several management agencies are keen to be involved in the exciting next stage of the project. So, we are seeking a motivated student who wants to get involved. To help, we are offering a fully funded PhD scholarship to work with our team (led by Dr Carly Cook at Monash University).

If you are a conservation practitioner and have a management case study that you would like to test the decision-triggers concept on, or feel you have a good example of decision triggers already in place, please let us know.

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Note: Kelly and Carly were CEED Postdoctoral Fellows during the period this research was undertaken (and are now CEED Alumni). This work was done with the support of the National Environmental Research Program (NERP) Environmental Decisions Hub, a partner network of CEED. Prue is currently based at Oxford University at the Interdisciplinary Centre for Conservation Science, Kelly is at the University of Melbourne and Carly is at Monash University.

References


Bigger is not necessarily better?

Focusing on spatial size can produce a raft of perverse outcomes

By Megan Barnes (University of Hawaii) & Louise Glew (WWF)

Using size as the sole or even primary measure of success risks wasting limited political and social capital on protecting areas that don’t maximise conservation benefits. That’s the warning of a new commentary we led (while based at CEED) in *Nature Ecology and Evolution* (Barnes et al, 2018). Focusing on area is dangerous because we risk protecting a lot of land and sea with limited biodiversity benefits.

International targets adopted under the Convention on Biological Diversity (CBD) include the protection of at least 17% of land and inland water, and 10% of coastal and marine areas by the year 2020 (Aichi Biodiversity Target 11). Special emphasis is placed on areas of high ecological importance, but a frenzied race to hit a spatial percentage target risks ignoring impacts which undermine the underlying conservation goal (see Fig 1).

Impact on biodiversity is broadly recognised as the crucial measure for protected areas by scientists, conservationists, and policymakers, but current policy discussions around global protected area targets continue to focus heavily on area under protection, rather than outcomes for conservation.

Using size alone to measure conservation success is like counting the beds in a hospital and ignoring whether or not the patients are getting better. We don’t just need more protected areas, we need to maximize our return on protected area investments. This means parks and reserves established in the right places, protecting as many species, habitats, and ecological functions as possible.

The danger of so-called ‘paper parks’ – protected areas that exist on maps but fail to deliver significant conservation benefits – extends beyond just local inefficiencies. Their establishment often leads to an exaggerated public perception of success, fostering complacency and excusing inaction elsewhere. Alternatively, these areas lack of demonstrable conservation impact can reinforce arguments against protecting other areas – often ones of critical ecological importance.

The way international policy targets are currently designed, we risk ‘locking-in’ a globally protected area estate designed to maximize area, not impact, particularly in countries where public or political appetite for expansion of parks and reserves is limited. By creating parks with limited impact, we reduce the benefits people see, and with that we lose social license for conservation.

We argue that policymakers, governments, and NGOs must stop measuring protected area success on size alone and start talking about things like how many fish will stay in the sea to grow and reproduce, or how many pangolins might be saved from wildlife trade.

Importantly, the upcoming renegotiation of the CBD Targets in 2020 provides a critical window of opportunity to ensure future protected area establishment is smartly targeted to achieve global conservation goals.

If we want future conservation targets to focus on measurable outcomes beyond area, we need to act now. We know we can’t protect everything, so let’s make sure what we do protect gives us the biggest return possible.

Reference

Managers, policy makers, and decision makers with responsibility for environmental decisions have an extraordinarily difficult job. The systems they manage are complex (coupled human-natural systems), with many dimensions and complicated dynamics. Our knowledge of how those systems respond to management actions is limited, so many of the decisions have to be made in the face of uncertainty.

Navigating the field of decision analysis

Helping decision makers frame, analyze, and implement decisions

By Michael C. Runge (U.S. Geological Survey) and Eve McDonald-Madden (University of Queensland)

Managers, policy makers, and decision makers with responsibility for environmental decisions have an extraordinarily difficult job. The systems they manage are complex (coupled human-natural systems), with many dimensions and complicated dynamics. Our knowledge of how those systems respond to management actions is limited, so many of the decisions have to be made in the face of uncertainty.

Key messages:

1. **All decisions have the same recognizable elements.** Context, objectives, alternatives, consequences, and deliberation. Decision makers and analysts familiar with these elements can quickly see the underlying structure of a decision.

2. **There are only a small number of classes of decisions.** These classes differ in the cognitive and scientific challenge they present to the decision maker; the ability to recognize the class of decision leads a decision maker to tools to aid in the analysis.

3. **Sometimes we need more information, sometimes we don’t.** The role of science in a decision-making process is to provide the predictions that link the alternative actions to the desired outcomes. Investing in more science is only valuable if it helps to choose a better action.

4. **Implementation.** The successful integration of decision analysis into environmental decisions requires careful attention to the decision, the people, and the institutions involved.

Above: The field of environmental decision analysis has come a long way in recent decades. So much so that the richness of decision-making approaches can sometimes seem overwhelming. Underlying that richness are a few basic elements and processes. In this article we present some key elements to help point the way.

The field of decision analysis provides a comprehensive set of tools for structuring, analyzing, and making decisions. Arising initially as a way to understand and manage risk, the field has expanded in the last 80 years to cover such topics as multiple-objective trade-offs, time-dependent linked decisions, value of information, and competition among multiple decision makers. At the same time, cognitive psychologists have studied human decisions to understand when our innate processes work and when they fail.

Formal decision analysis is increasingly being used in many sectors, including economic, industrial, manufacturing, agricultural, transportation, and medical sectors, by individuals, corporations, non-profits, and government agencies. Occasional application of decision analysis to environmental decisions began in the mid-1970s, but the environmental science and management world was largely unaware of decision analysis until the late 1990s and early 2000s. (A major aim of the ARC Centre of Excellence for Environmental Decisions – CEED – was to better connect decision analysis and environmental management).

Today, the field of environmental decision analysis is coming of age with the maturation of a rich set of tools to help decision makers frame, analyze, and implement decisions. Sometimes this ‘richness’ itself is overwhelming (especially when considered with the complexity of the systems we want to make decisions about), but there are core principles that tie decision analysis together. To help the reader navigate this complexity, we summarize the field of decision analysis in four key messages.
1. All decisions have the same recognizable elements

The decisions we have to make are normally surrounded by a fog of complexity. One of the most valuable contributions of the field of decision analysis is the recognition that all decisions have a common set of elements: context, objectives, alternatives, consequences, and deliberation. These elements form a useful guide for the decision maker.

**Context:** Albert Einstein once said that if he had 1 hour to save the world he would spend 55 minutes defining the problem and 5 minutes finding the solution. Clarity about the decision context leads to an efficient search for solutions.

Understanding the decision context begins with some simple questions (simple to ask, anyway). What is the problem that is being faced and what triggered it? Who will make the decision and what authority do they have to act? Who else cares about and can influence the decision? What is the geographic and temporal scope of the problem? What ecological, social, and legal background is relevant?

**Objectives:** The decisions that we make are driven not by science but by the values we hold. Understanding the value sets of the decision makers, the organisations responsible for decisions, and the key stakeholders is a crucial step in a structured approach to decision-making.

The values at the heart of any decision are the fundamental objectives—the long-term outcomes we are trying to achieve by implementing a course of action. There are often many of these objectives, and they might conflict. Thus, we might care about the long-term conservation of wetland birds at the same time we care about maximizing agricultural production and minimizing flooding risk.

We often lose track of fundamental objectives by focusing instead on means objectives. These are potential ways by which we might achieve our fundamental objectives. For example, we might focus on target levels for irrigation withdrawal and argue over those, forgetting that what we really care about are the birds, the crops, and the flood protection.

**Alternatives:** Once we know what we want to achieve with a decision, it’s possible to start thinking about what we could do to achieve these outcomes. Unfortunately, most people reverse this process, assessing what they could do before understanding why they are doing it.

While working out what actions we can take to achieve our objectives seems simple, the process is hampered by psychological biases. Often we anchor on the decisions we have made in the past or small variations on those decisions (see **Decision Point #93**). But to achieve a good decision, we need to be creative, to think beyond our current set of actions and our means objectives, and instead focus on developing actions that may help us achieve our fundamental objectives and expose trade-offs within these objectives. Indeed, given the challenges we face in environmental management, creative solutions are needed more than ever, and sticking with business as usual is unlikely to solve the problems we have.

A creative search for alternative actions should challenge constraints. Many constraints to a decision are only perceived, not real. We may be told, for example, that a decision has a firm budget constraint, but creative consideration of leveraged funding might open up new alternatives.

**Prediction of consequences:** The role of science in decision making is to make predictions. There are no decisions without prediction. If you decide what bus to take, you think about what time you need to get somewhere and predict which bus will get you there in time. We make predictions daily for every decision we make.

What are these predictions? They are a mapping of the actions we are choosing among (the alternatives) to the things we want to achieve (the objectives). The challenge for the scientist is to use the best available information to make these predictions, while comprehensively accounting for uncertainty.

**Selection of preferred alternatives:** By this point of the process we have evaluated each action or set of actions against each objective. But no decision has been made, yet, and indeed, the best choice might not be obvious. In the deliberations to find a preferred alternative, the decision maker might need to weigh the multiple objectives to find the right balance, or consider the risk posed by uncertainty, or consider how this decision will affect future decisions. These are challenges at the interface of science and values, and the field of decision analysis provides a large set of tools to help.

2. There are only a small number of classes of decisions

Many decisions resemble each other, and this recognition is one of the ways that people become better decision makers and analysts, because they realize they have made a similar decision in the past. For a decision analyst, each class of decisions has a common structure, poses a similar challenge to the decision maker, and benefits from a similar set of analytical tools. Although the circumstances and details of each environmental decision are unique, recognizing the class of decision accelerates the process of analysis. Here we discuss five classes of decisions that arise commonly in environmental contexts.

1. **Risk analysis:** Coupled socio-ecological systems are complex, our knowledge of how they respond to management actions is limited, and some aspects of their dynamics are out of our control. Thus, many environmental decisions are made in the face of uncertainty and are open to risk. A grassland manager, for example, in an effort to hold back succession, can choose between mowing and burning. The effects of mowing are better understood and more controllable, but the disturbance does not return the same nutrients to the soil nor does it induce germination. On the other hand, even with careful preparation, it is hard to fully control a burn. What are the risk trade-offs in choosing among these actions?

Risk decisions are ones in which the precise outcomes of the alternative actions are not known prior to implementation. The challenge for the scientist is to estimate the probabilities of the various outcomes under the different alternatives. The challenge for the decision makers is to articulate their degree of risk tolerance. The methods for risk analysis are well developed and have been applied in a number of environmental contexts, including endangered-species management, biosecurity, and pesticide regulation.

2. **Project prioritization:** Consider an agency that has $300,000 to spend to restore instream, riparian, and upland habitat for the benefit of a suite of threatened endemic species. The agency has received several dozen proposed projects, ranging in cost from $10,000 to $175,000. Taken together the projects...
cost $1.4 million, far in excess of the available funds. Which of the projects should be funded to assure the most benefit for the species in question?

This common class of problem goes by many names including portfolio allocation, the knapsack problem, or combinatorial optimization. In the environmental world it is frequently called project prioritization (see Decision Point #29, p8-10; and Decision Point #103). The challenge is to select a subset of a large number of possible projects, subject to a budget or resource constraint, that maximizes the combined benefit.

The number of possible portfolios to select is typically very large (for example, with 24 projects to select from, the possible number of combinations is $2^{24} = 16.8$ million). The benefit of adding a particular project may depend on what other projects are in the portfolio, because there could be synergies, conflicts, or redundancies among projects. The analytical challenges are to calculate the net benefit of a candidate set of projects, then search among the large set of possible portfolios for the optimal one.

Note that a broad set of decisions is included in this class. The ‘projects’ could be species to save, invasive species to combat, research projects to fund, land parcels to acquire, varieties of actions to implement, etc. The resource constraints could be money, staff time, the total number of projects to undertake, or even the number of individuals of a threatened species available for translocation.

3. Spatial planning: Spatial planning is a special case of project prioritization. The individual ‘projects’ are spatial elements (eg, the overall program objective, the probability of success of that action, and of course the cost of implementing that action.

To select the best monitoring regime we include the same components, but the benefits now relate to the quality of information needed to make a decision based on the reason for monitoring (eg, track system state to guide state-dependent management, or track performance to guide adaptive management). Furthermore, adequate monitoring must consider the ability of the strategy to detect changes in the system.

Acquiring information on benefits and costs for a decision analysis can be achieved through expert elicitation or through more detailed scenario modelling. Options for implementing decision analysis range from a simple calculation of the combined benefits relative to the total costs incurred (eg, Benefit / Cost) to a more complex optimisation (eg, stochastic dynamic programming or reinforcement learning). Methods of obtaining data and implementing decision analysis vary in their cost and their ability to provide rigorous results.

Reference
And see Decision Point #52, p4-6.

Figure 1: A decision tree for deciding when to implement monitoring to improve conservation management (and when not to). From Macdonald-Madden et al, 2010.
land parcels, grid squares), and the challenge is to identify the best set of spatial units to include in the reserve to maximize some measure of environmental benefit, while either staying within budget or minimizing the area required. The nature of the interactions among the units can be important, reflecting the benefits of connectivity but possibly also the value of spatial independence.

In the past two decades, a set of tools has been developed to aid governments or other management agencies in spatial planning: identifying where to locate and how to configure areas that should receive some sort of protection to conserve their natural processes. Related tools are used in contexts like urban planning, electoral districting, and school zoning.

4. Recurrent decisions: Many natural resource management decisions are made repeatedly; the same, or a similar, decision is revisited on a recurrent basis. For example, hunting seasons, fishing catch limits, or quotas for subsistence take are often set on an annual basis. Likewise, timber management decisions within a large forest are made recurrently. In some parts of the world, the inundation of wetlands is managed on a seasonal or annual basis to provide habitat for migrating species, encourage primary productivity, or set back succession.

Recurrent decisions are challenging because the systems are dynamic. An action taken in one cycle, which might generate a short-term benefit, changes the trajectory of the system, affecting the actions that can be taken subsequently as well as the benefits that will arise from them. To calculate the long-term benefit of taking an action today, we have to anticipate all the subsequent actions that will be taken over the timeframe of management.

5. Multiple objective trade-off decisions: One of the emblematic environmental issues of the late 20th Century in the United States was the development of the Northwest Forest Plan, which exposed conflicts between conservation of the northern spotted owl and maintenance of an old-growth timber industry. These challenges are ubiquitous in environmental decisions—humans have multiple objectives they would like to achieve from an ecological system, like biodiversity conservation, economic growth, recreation, provision of ecosystem services, and maintenance of subsistence harvest, but it might not be possible to achieve them all to their highest degree. How should these trade-offs be managed?

Multi-criteria decision analysis provides a set of tools for structuring, analyzing, and negotiating multiple objective decisions. The core challenge for the decision maker is a values question, not a scientific one—what is the relative value of the multiple objectives?

3. Sometimes we need more information, sometimes we don’t

Uncertainty surrounds all the decisions we make. It’s something we must capture in our predictions and consider in our final decision. Sometimes, reducing that uncertainty can improve our ability to make a decision. However, sometimes additional learning won’t change our choice of action. Recent advances provide tools for understanding when new science is needed.

Monitoring: Monitoring is generally viewed as a ‘smart’ activity in the pursuit of improved conservation outcomes. By explicitly asking the question, “Is spending money on monitoring justified?”, we must be prepared to not monitor in some cases. Good monitoring rests fundamentally on a clear justification for acquiring information in the first place. That is, what we strive to know should be driven by what we need to know (see Decision Point #52, p4-6, and see the box on analysis and monitoring).

Value of information: Most information gathered about the natural world does not help inform decision-making. This is the crux of value-of-information analysis (see Decision Point #67). It is about asking whether money and time spent collecting data might change our decision. It recognizes that gathering information costs money, delays actions, and takes resources away from management. Formal value-of-information analysis can lead to more efficient allocation of resources.

Adaptive management: Adaptive management, sometimes called ‘learning whilst doing’, is a formal approach to making linked decisions in the face of uncertainty. More than just trial and error, adaptive management embeds the idea of value of information into monitoring design and experimental actions, so that management actions can improve over time. (See Decision Point #102)

4. Implementation: requires careful attention to the decision, the people, and the institutions involved

Environmental decisions are hard, not only because their elements are complex and multi-faceted, but because the political and institutional settings in which they are made are filled with passionate, contentious and diverse people. Faced with this complexity, decision-analysis tools are very attractive. They give us the hope of structured, rational deliberation. But these tools don’t actually make the decisions. They are only aids for the decision makers, not prescriptions. Further, we are as distrustful of other people’s processes as we are of their policies, so the proposal to even undertake decision analysis is itself often contentious.

If these reservations can be overcome, however, decision analysis does offer a rich set of tools to enhance the deliberation behind environmental decisions. Overcoming those reservations requires attention to the interpersonal, institutional, and political dynamics surrounding the decision. Here are three suggestions that may help overcome some of these reservations:

(1) Use rapid prototyping to sketch an initial decision analysis. Minimal initial investment with the opportunity for substantive input may invite decision makers and stakeholders into the process.

(2) Pay attention to who the decision maker is. In complex institutions (like government agencies), it may not be immediately clear who will end up making the decision.

(3) Recognise the importance of stakeholders and the possibility of multiple decision makers. Deeply political settings involve multiple decision makers, who may not agree to cooperate. Recognition of this dynamic can lead to strategies for negotiation, compromise, and forward progress.

Making good decisions about and for the environment is enormously challenging. Rather than throwing our hands up and saying it’s all too hard, decision makers stand to make considerable gains if they can better engage with the rich and growing field of decision analysis.

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Environmental context is critical for fire management

Guidelines need to look beyond species traits for good outcomes

By Claire Foster (ANU)

Guidelines for fire management of different vegetation types are often based on the traits of individual species occurring within these habitats. For example, if obligate seeding shrubs that take 5-7 years to mature occur in a particularly vegetation type, a minimum fire interval of 7 years might be prescribed (because anything less than that might see the shrub burnt before it can set seeds for the next generation, resulting in the loss of that species).

While guidelines such as these are a useful indication of fire intervals that should be avoided to prevent the loss of species, they are not so helpful in suggesting what kinds of fire regime managers should be aiming to achieve across a park or reserve. Further, this focus on individual species traits mean that vegetation types that have many species in common often have similar fire management guidelines, even if they differ substantially in structure, productivity and environmental characteristics. An important question therefore is whether this trait-based approach to recommended fire intervals is adequate. Or should managers be aiming for different fire regimes for different vegetation types, even when those vegetation types have many species in common.

To test this question we studied the association between the recent fire regime and the plant community in three common vegetation types of coastal south-eastern Australia: dry sclerophyll forests, woodlands, and heaths. These vegetation types often occur together in complex spatial mosaics, and many species occur in multiple vegetation types. For example, in our study, 72% of the species we recorded in heath vegetation were also found in woodland sites. This similarity in species composition means that recommended fire intervals (also known as tolerable intervals) for these vegetation types are very similar: minimum intervals of greater than 7 years and maximum intervals of 30—50 years. In our study area, very few sites had experienced fire intervals outside of this range. Our study therefore tested whether, within tolerable intervals, fire regimes have different consequences for plant species richness in different vegetation types.

The effect of time since the most recent fire was consistent across vegetation types. Sites which had burnt within the last 10 years had on average 3-4 more species than sites which had not burnt for over 30 years. This pattern is common in Australia's fire-prone ecosystems. It’s the result of short-lived plant species germinating soon after a fire, then flowering, setting seed and dying within a few years. These species may not be visible after this but they are still present, surviving the long period between fire as seeds rather than living plants.

In contrast to the result for time-since-fire, we found that the effect of fire frequency on plant species richness was completely different (in fact opposite) in different vegetation types. In dry sclerophyll woodland, sites that had burnt 4 to 6 times in 55 years contained around 15 to 20 more species than sites that had only burnt once or twice in that period. However, in heath vegetation, sites which had burnt 4 to 6 times contained around 10-20 fewer species than sites which had burnt only twice. As these two vegetation types had nearly 70% of their species in common, this result is unlikely to be due to differences in the composition of these vegetation types. Rather, we believe that this result has occurred because plants have responded differently to fire (and the conditions after a fire) in these different vegetation types. These differences in fire response are likely to factors such as fire intensity (how hot a fire is when it burns), competition from overstorey and midstorey species, and soil and water availability, all of which differ among vegetation types.

We found support for the idea that different vegetation types can lead to different fire responses when we looked more...
Fire is a major structuring process of terrestrial ecosystems, especially in Australia. And managing fire is an enormously challenging and complex task, with high risk and enormous consequences for humans and nature when we get it wrong. Given this, making good decisions around our approaches to fire has always been difficult and often contested. The Decision Point archive contains many stories on fire and its management. Here are some examples:

- **Fire in the foothills**
  Fire regimes and environmental gradients shape the distribution of forest wildlife

- **Fire to promote wildlife conservation**
  Understanding how pyrodiversity begets biodiversity

- **Fire and reptiles**
  Are prescribed burning targets appropriate for reptile conservation?

- **Opinion under fire**
  Evidence vs opinion: What really protects houses from wildfires?

- **Prescribed burns for multiple objectives**
  Fire management for asset protection and the environment

- **Burning questions for black cockatoos**
  Fire may hold the key to the future of Carnaby's cockatoo

- ** Targets and burning issues**
  State-wide percentage targets for planned burning are blunt tools that don't work

- **Of fire and genetic diversity**
  Using genetic information to better manage biodiversity in a changing world

- **Carbon, fire and biodiversity out on the savanna**
  Prioritising land management to achieve dual benefits

- **Fighting fire with logic: protecting biodiversity & houses**
  Effective decision making resolves conflicts in fire management

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**Reference**

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Recently burnt woodland vegetation. (Photo by Chris MacGregor)
Alumni stories

CEED alumni make their mark

One of CEED’s greatest legacies will be its people. CEED commenced in 2011 and has now generated a well-connected alumni network that spans the globe. These incredibly capable researchers are receiving national and international recognition for their achievements. They are securing coveted positions in the academy, and also taking up leadership roles in governmental and non-governmental organisations. We are profiling a selection of this community in this and coming issues of Decision Point. And, if you have any alumni tales to share, please let us know.

Carly Cook

CEED allowed me to meet and collaborate with world-leaders in decision science.

I joined CEED in 2011 after completing my PhD at Queensland Uni. CEED provided an outstanding intellectual environment for me to develop as an independent researcher. Richard Fuller and Hugh Possingham were fantastic mentors for me, contributing to the science I was conducting and in providing invaluable advice about how to develop my career in conservation science.

One of the many ways in which CEED benefited me, was through an early-career-researcher travel grant. The award allowed me to travel to the UK to meet with leaders in the field of evidence-based conservation: Bill Sutherland from Cambridge Uni and Andrew Pullin at Bangor Uni. This experience had a lasting impact on my career. It enabled me to form collaborations with both research groups, and encouraged me to become one of the founding members of the Australian arm of the Collaboration for Environmental Evidence: the Centre for Evidence-Informed Policy and Practice.

I am now a lecturer at Monash Uni where I have also started my own research group. Our focus is on integrating evidence into conservation decisions and developing decision support tools.

More info: https://carlycookresearch.wordpress.com/

Note: You can read about some of Carly’s recent research on decision triggers in management on page 8.

Strategies to bridge the divide

Back in 2013, Carly wrote about mechanisms that help scientists and decision makers work together. In Decision Point #73 she wrote: “We perceive at least three key challenges for those hoping to achieve boundary-spanning conservation science. First, scientific and management audiences can have contrasting perceptions about the salience of research. Second, the pursuit of scientific credibility can come at the cost of salience and the legitimacy of science in the eyes of decision makers, and third, different actors can have conflicting views about what constitutes legitimate information. The key to overcoming all three challenges is through meaningful collaboration between scientists and decision makers.” And she then outlines four strategies as a good place to start.

Ed Hammill

When I joined CEED in 2013 I had no formal experience in spatial analysis but I did have a strong desire to work in decision science for conservation. While with CEED, I learned how to implement the spatial planning software Marxan, and developed a new method to analyse the consequences of not accounting for risk in landscape decisions. I’ve continued to use both these techniques in the majority of the projects I have taken on (which have expanded to include rivers and streams).

My experiences at CEED provided me with the skills to produce high-impact publications, including one in Nature Communications (which then became the subject of a TED talk). And due to the highly collaborative nature of CEED, my time there also allowed me to substantially expand my research network. The CEED conferences were not only useful to meet researchers from other universities, but provided a great sense of being part of a large group focused on the same mission.

Following my time at CEED, I have taken up a faculty position at Utah State Uni, where I lead the Spatial Community Ecology lab. The techniques I learned during my time at CEED were crucial in obtaining this position and my subsequent success. Recently, I began working with state agencies and The Nature Conservancy to address how the threat of climate change should be incorporated into management activities in the western US. This year, I will start working with the Department of Defence to investigate how best to conserve endangered aquatic species on military lands in California.

I will also be continuing the work I began during my time at CEED, investigating how the risk of armed conflict should be incorporated into conservation decisions. None of these projects would have been possible without the collaborations and skills I developed while working at CEED.

Aim high young man! Ed Hammill in full flight at the 2013 Biennial CEED Conference Great Debate in which the contested proposition was that hunting, logging and grazing should be allowed in national parks. Ed led the opposition which, for the record, won the debate. Seated behind Ed in lumber-jack costume and beard is Sarah Bekessey.
Melinda Moir

CEED not only opened doors to people who I thought were out of reach (or I was not even aware of) but it also generated a supportive atmosphere. The support that I received was substantial and came in many forms: moral, financial and professional (including mentorship and meeting world-renowned scientists). I have attempted to replicate this environment of support for the people who work for me at the WA Department of Primary Industries and Resource Development, which I joined in 2015 after finishing at CEED’s UWA Node. I lead a team working on the biosecurity of Barrow Island, an A-class Nature Reserve off Western Australia’s northwest coast (associated with Chevron-related mining activities on the island).

My CEED journey began in 2010 at the Melbourne Uni node, with Peter Vesk and Mick McCarthy. I have many fond memories, but one of the best was attending the ESA conference in Canberra in 2010. Not only was it an opportunity to meet all the great people associated with CEED, but it gave me the feeling that I was a part of something that was really going to make a difference to the conservation of Australia’s biota in the long-term.

Threatened plants & their dependent insects

Way back in Decision Point #53, pages 6-7 Melinda wrote about co-extinction and how to stop it. As she explained: “When we move a threatened plant species to a new site to improve its chances of survival, should we be putting in a similar effort into moving the insects that live on that plant? If those insects only live on the threatened plant species then clearly we should. Unfortunately, not much work has been done on this aspect of translocation.”

In the above image Melinda is pictured vacuuming insects from threatened plant species using a petrol-powered weed blower. Her field site in the SW corner of WA. (Photo by Kec Brennan)

Joe Bull

To this day, I still collaborate and publish with CEED, so I am not sure I truly ever left! However, since finishing my PhD, and official association with CEED, I have gone on to pursue a career in applied biodiversity conservation research through postdocs and other institutional positions. This has included winning funding for projects, including a ‘no-net-loss’ project in Uganda and a ‘business-and-biodiversity’ project with the University of Oxford. I have also set up a biodiversity consultancy called Wild Business that puts our research into practice. We have worked on numerous conservation projects throughout the world, from Canada to Kazakhstan.

I first became part of CEED in 2011 as an associate while undertaking a PhD at Imperial College London. In my first year I organised a biodiversity offsetting workshop with Sarah Bekessy’s group at RMIT which kicked off a number of collaborations that have proven incredibly productive (both during my studies and beyond). Through exposure to leading thinkers in decisions science and working with such applied conservationists, I greatly benefited from my time with CEED. In fact, my best publications have all involved CEED collaborators.

CEED also strongly influenced the way I approach science, encouraging me to think more creatively and practically about my research and its outcomes. Without this influence, I might have gone back to industry instead of continuing along this path. It’s fair to say, CEED has also been a key motivator in deciding to remain primarily in academia.

Comparing offset methodologies

In 2015 Joe analysed how different offset schemes worked around the world. In Decision Point #85 he told us that: “Since the basic goal of all of these methodologies is the same – that is, no net loss – one might hope that they would give similar answers if they were applied to a common case study. We tested this approach and it turns out they don’t. This highlights how different the philosophy behind biodiversity offsetting in different countries can be.”

Figure 1: Comparing different schemes – a plot of net weighted area of land at benchmark condition (in km²) against time (in years) resulting from hypothetical offsets in Uzbekistan, using different methodologies. See the story in Decision Point #85 to find out which line represents which country.
If a tusk burns does anyone see

If a tree falls in a forest but no-one sees it, did it really happen? What if you staged a mass tusk burning as a signal to world that ivory poaching is not worth it. Is anyone noticing? This was the question posed by an international group of scientists (including several CEED researchers).

Ivory poaching is taking an enormous toll on African elephants. In recent years there has been some success with enforcement resulting in stockpiles of seized tusks. These stockpiles are then destroyed in mass burnings designed to send out a strong message against ivory consumption. But is the message getting through? University of Queensland researcher Alexander Braczkowski and colleagues set out to see by analyzing media coverage of a recent mass burning in Kenya, the largest ivory-destruction event so far. They examined the media impact across eleven important nations to the ivory trade.

“We found most online news on the ivory burn came from the US (81% of articles),” says Braczkowski. “Print news was dominated by Kenya (61% of articles). We subjected online articles from five key countries and territories to content analysis and found 86–97% of all online articles reported the burn as a positive conservation action, while between 4–50% discussed ivory burning as having a negative impact on elephant conservation. Most articles discussed law enforcement and trade bans as effective for elephant conservation.”

Duan Biggs, a CEED alumni and co-author on the study, said that with no real measure of the effectiveness of these conservation marketing events, there is no way of judging if they achieve their objectives of reducing ivory demand and supporting elephant conservation.

“If ivory consumers, poachers, dealers and policy makers were the intended audiences, then a strategy of sustained media pressure to extend news coverage to weeks or months may have been better intended, but the message was lost.” Biggs. “These destruction events should also coincide with key meetings of policy makers, with more leaders of source, transit and demand countries invited to attend.”

Check out CEED's interactive photo story on this research.

Of tusks and taboo trade-offs

And while we're on the topic of tusks, late last year Duan Biggs and colleagues scored a paper in the prestigious journal Science. They contend that the deadlock on ivory could potentially be overcome through a structured process which incorporates both values, differing perceptions of trade-offs, and scientific evidence. The taboo trade-off (when one trades off a secular value like money with a sacred value like “elephants are sacred and therefore selling ivory is wrong”) is a hitherto un-addressed issue in the ivory debate (and is also relevant to the trade of other iconic species like rhinos and turtles).

http://science.sciencemag.org/content/358/6369/1378

The Singapore connection

Researchers from UQ, CEED, the National University of Singapore (NUS), and staff from the Singapore National Parks Board (NParks), met in Singapore in early February to strengthen collaborative links between conservation researchers and managers.

Scientists and managers from NUS and NParks gave talks providing an overview of Singapore's current conservation and parks management arrangements, and discussed research needs and challenges. Six speakers from UQ (Kerrie Wilson, Angela Dean, Marie Dade, Micha Jackson, Jeff Hanson and Chris Baker) then delivered a well-attended public seminar focussed on applying decision science to conservation.

A day of workshop followed with the aim of identifying the relative needs, strengths and areas of research expertise across the institutions, and to discuss potential areas of and mechanisms for ongoing research collaboration. Particular focus was given to novel ecosystems, coastal development, and urban green infrastructure; all of which are of particular relevance to Singapore (and in which CEED has a depth of experience). Following the workshop, UQ visitors were treated to an outing at the Labrador Nature Reserve hosted by NParks staff.

“The two days provided important insight into the significant challenges of reconciling development, human needs and conservation goals in the Asia Pacific region,” says CEED’s Director, Kerrie Wilson. “By collaborating across academic institutions and working with government partners we will be much better placed for identifying workable solutions to their challenges.”

Special thanks goes to Dr Kwek Yan Chong and his research staff for their efforts in enabling this highly valuable workshop.

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