Decision Point

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Connecting conservation policy makers, researchers and practitioners

Smart science for wise decisions

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Decision Point is a monthly magazine presenting news, views and ideas on environmental decision making, biodiversity, conservation planning and monitoring. It is produced by CEED - the ARC Centre of Excellence for Environmental Decisions. For more info on Decision Point, or CEED, see the back page or our website at http://ceed.edu.au/
A “Colombo Plan” for regional biodiversity conservation
How to build a truly great biodiversity legacy

By Hugh Possingham (Director, CEED)

The vast majority of the research that is communicated through Decision Point is funded by Australian taxpayer’s dollars from Australia’s governments (especially SEWPac and the ARC), or Australian Universities (also in part taxpayer’s dollars) with some scattered industry and international funds. But much of our research is used by agencies in other countries. Don’t we have enough problems of our own? Why would we spend time writing papers about prioritising threatened species in New Zealand, optimal methods for surveying tigers in Sumatra and conservation investment in the coral triangle? There are at least four answers.

First, for everything we give away we get plenty back. Discovery research is just that, finding out new things or posing and solving problems that have never been solved before, anywhere in the world. If it is in the international peer reviewed literature then, if the system is working, it is genuinely novel. Furthermore, most of the ideas, discoveries and tools transcend continental boundaries and are useful to everyone. Tools and techniques for making decisions about prioritising actions and monitoring work anywhere.

Second, given Australian applied ecology is only about 5% of global applied ecology – we get back about 20 times what we put in. By making our contribution we buy a seat at the cooperative venture of science – which includes sharing discoveries, people and ideas through many mechanisms like conferences, exchanges, training and publications. Cooperation and sharing avoids reinventing the wheel, and scientists are relatively cooperative at a global scale.

Third, “no country is an island” … with respect to biodiversity. Australia’s biodiversity is interconnected to our neighbours through many processes ranging from the direct movement of animals like whales and waders, through the long-term evolutionary and ecological processes that enabled the Great Barrier Reef to have much of its biodiversity arrive from the north over the past 12,000 years. Failing to work with our Asian and Pacific neighbours to protect their biodiversity threatens the long-term persistence of our biodiversity.

Fourth, we should shoulder global responsibilities in biodiversity conservation much as we shoulder global responsibilities with respect to human rights and health. Here Australia has an enormous, but largely unfulfilled opportunity. I estimate that somewhere between Burma and Fiji, taking in Brisbane on the way, there are about a third of all terrestrial species on the planet packed into 10% of the world’s land. And as we know from previous Decision Point stories – the coral triangle, the marine area in the middle of that broad transect, has no parallel on the land in terms of the richness of its marine biodiversity.

Yet many of these countries have limited capacity to do the conservation research they need to. Training and skills in ecology, conservation, GIS, ground tactic sciences and conservation economics are absent or limited. Drs Klein and Grantham and myself recently returned from teaching a Maxtran course in Sabah, Malaysia. The ‘students’, who ranged from government and NGO staff to university students, were talented, engaged and enthusiastic. However Malaysia, which in some respects is richer and more sophisticated than Australia, has few tertiary teachers or researchers in conservation. What can, or should we do?

Every year Cambridge University hosts a Student Conference on Conservation Science (http://www.sccs-cam.org/). The model has been transported abroad and when I was there a few years ago as one of their plenary speakers, I asked them if we could steal their idea. (Well, we stole everything else from the Poms, why not this.) They were more than enthusiastic.

The Student Conference on Conservation Science is more than just another conference. The only participants are research students, especially MSc and PhD students. It emphasizes participation by students from developing countries and it works on building networks and skills. The thought is that these networks will enable conservation professionals to be far more effective in the long term.

Our trip to Sabah reminded me of the importance of this sort of event and the long-term benefits it delivers. Hence we will commit to doing the same here, as soon as we can, with a special focus on research students from South East Asia and the Pacific. If we were to pull this off and keep it going, it could prove to be our greatest biodiversity legacy – an effective and self-supporting network of conservation research professional across the region.

“A network of conservation research professional across the region - it could prove to be our greatest biodiversity legacy.”

Conservation managers and students at a Marxan workshop in Sabah, Malaysia last year. Malaysia has few tertiary teachers or researchers in conservation yet is responsible for some our planet’s most biodiverse regions. (Image by Sofia Johari)
Face down in a field
Beware of those charismatic fast growers

By Yvonne Buckley

From a train a man was observed lying face down in a field. On the train’s return journey the next day he was still in exactly the same position. This led some of the passengers to think he was dead.

But, he wasn’t dead. He was just practicing his trade. You see, he was a plant demographer.

Years of pain staking data collection, face down in fields, have led to the construction of a data-base of thousands of population measurements for over 50 plant species. This has enabled us to determine two surprising facts:

1. The longer you study a plant population, the more its population growth rate declines; and
2. The variability in population growth rate through time was more predictable than we had expected, a good year was quite likely to be immediately followed by a bad year.

As every first year science student knows, correlation does not imply causation so we cannot recommend putting ourselves out of a job by halting all long term demographic studies in order to prevent rare plant declines. However, this might instead tell us something about how we go about setting up our studies.

The short-cut of studying multiple populations for short periods of time in lieu of following populations over longer time periods is not necessarily a good one.

We need to be careful about not just choosing the charismatic fast-growing populations to study (even if it adds excitement to the daily grind of being face down in a field). Indeed, it’s important to include both fast and slow growing populations as starting points. Fast growing populations must at some point slow down (otherwise they’d take over the world), so perhaps it’s inevitable that we find the large showy charismatic populations to be ultimately disappointing.

As populations vary more in time than in space with good years followed by bad and vice versa, the short-cut of studying multiple populations for short periods of time in lieu of following populations over longer time periods is not necessarily a good one.

The peril, therefore, that will continue to be faced by plant demographers as they collect data is that, instead of flitting about from field to field, they will appear to be dead – year after year.

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Reference

The process in making adaptive management meaningful

Using process models to guide investment in the management of native vegetation

By Libby Rumpf (University of Melbourne)

Despite significant investment and decades of effort to reverse widespread declines in species and habitat, most indicators are suggesting the situation is only growing worse. What’s more, resource management agencies have found it difficult to demonstrate how the investment of public funds has contributed to positive ecological change.

Of course, demonstrating the return on investment in natural resource management (NRM) is always a major challenge. Management interventions are made over a range of scales in time and space, and the behaviour of the ecological systems we’re dealing with is highly complex and variable. The sin is not that we haven’t tried to manage for positive change; rather it’s that we haven’t effectively learnt from our efforts. Ecologists and practitioners have generally failed to undertake structured learning from our successes and failures. Indeed, much data and priceless experience has essentially disappeared. With growing ecological pressures and increasingly limited resources, surely that’s unacceptable?

So, what do we need to do to effectively learn? What’s required is a management framework with clear objectives, a capacity to assess progress toward those objectives, and the ability to evaluate the extent to which particular management actions contribute to that progress. Adaptive management provides just such a framework.

Adaptive management is widely advocated and cited in scientific and management literature because it provides an explicit framework for motivating, designing and interpreting the results of monitoring so as to improve management. It’s a ‘learning-by-doing’ approach that acknowledges management action must proceed in the face of uncertainty, but facilitates learning through iterative updating of knowledge and management strategies.

So, why aren't we doing it?

If adaptive management is so appropriate and desirable, and the basic framework has been around for decades, why isn’t everyone using it? The reality is that there are very few successful examples in natural resource management, and in particular, native vegetation management. There are a number of reasons why this is so but one important factor thwarting its successful implementation is the failure to develop and use appropriate process models.

Quantitative process models are a core component of an adaptive management framework. They provide a formal structure to synthesise beliefs and knowledge about ecological system dynamics and the response of the system to management interventions. Consequently they help resolve uncertainties about management as they can be iteratively updated using monitoring data.

Quantitative process models enable ‘learning by doing’ by evaluating the extent to which management actions contribute toward achieving management objectives. With them, we facilitate better decision making. Without them, we risk perpetuating uncertainty about what the most appropriate management actions are in any given area, and it makes it harder to improve future decisions.

Which is not to say that current management approaches to vegetation management aren’t done with some model in mind. Ecological restoration actions are implemented with some underlying model in mind that predicts how the system will respond to intervention, though it is exceedingly rare for the model to be explicitly described within a management strategy, or even recognized as a model per se.

STMs for AM

A modelling approach which is becoming increasingly common in native vegetation management are state-and-transition models (STMs). These models describe different states of vegetation condition that may occur, and the possible transitions that may occur between these states. They are popular because there is recognition that there are different states of vegetation condition in the landscape with different land-use histories, multiple non-linear pathways of change between states, threshold behaviour, and possible barriers to restoration. Their adoption signalled a move away from the traditional views of Clementsian succession, whereby an initial management intervention (such as fencing or tree planting) will theoretically result in a single linear successional trajectory towards a 'climax' or reference vegetation community.

STMs can potentially provide a powerful approach to modelling ecosystem dynamics, but at present they are typically presented as conceptual models and not amenable to learning. Whilst there are examples of quantitative and STM simulation models, they are yet to be applied in adaptive management. That’s because STMs fail to meet three key requirements of adaptive management: 1) a capability to make quantitative predictions; 2) an ability to represent uncertainty; and 3) an amenability.

Figure 1: A process diagram for iterating states and transitions (from Rumpf et al 2010a). The states are discrete states of vegetation structure and composition that can be identified in the landscape, which are defined by various attributes of vegetation condition (ie, state variables). Independent factors control the conditions at the site, but cannot be modified at the site scale. Process variables are controlling environmental variables that can be modified at the site-scale by management actions.
Where are we going? The management of native vegetation for habitat and biodiversity is wickedly complex and the desired outcomes are expected to be highly variable in space and time. Traditional views of Clementsian succession assume that actions such as fencing or tree planting will inevitably end up producing climax vegetation communities. However, simple models such as these fail to acknowledge different states of vegetation condition in the landscape, and that different states arise from different land-use histories with multiple non-linear pathways of change between states. The popularity of state-and-transition models reflects a growing recognition that the 'climax' or reference community is not always a realistic, or necessary, endpoint.

Bayes nets are commonly proposed as a tool to develop and structure process models as they provide a method that is easily interpreted and intuitive for users, can be parameterized using a combination of data and expert knowledge, and are able to explicitly incorporate uncertainty. (continued on page 6)

"Ecological restoration actions are implemented with some underlying model in mind, though it is exceedingly rare for the model to be explicitly described within a management strategy.”
Out in the field

Doing adaptive management using state-and-transition models that incorporate Bayes nets as the modelling platform makes sense; but does it actually work with real problems and real data? We applied this approach to the adaptive management of native woodland vegetation in the Goulburn Broken Catchment in Victoria. We developed a model that incorporated the response of vegetation condition to various management interventions, environmental and land-use drivers (Figure 1).

Our decision was to model vegetation condition in two ways; as individual vegetation attributes, and as overall ‘states’ of vegetation condition (Figure 2). Identifying ‘states’ is an inherently useful undertaking for NRM agencies as it provides a tangible unit of measurement for vegetation condition that can be used to direct thinking about management objectives (ie, what are we trying to achieve with management?) and a reporting unit.

There were several reasons why it was also important to retain the individual vegetation attributes within the model. States are typically too coarse to detect meaningful changes in individual vegetation attributes, they cannot adequately represent uncertainty in the dynamics of those attributes, and they cannot be updated with new data. Management actions are often targeted at individual attributes (ie, weed cover and weed control), so a quantitative understanding of how those attributes respond to management at the scale of the site is crucial. And, finally, a quantitative model which defined states of vegetation condition in relation to these vegetation attributes would enable us to measure progress towards a transition to a new state. This is an important consideration as NRM agencies are commonly required to report on progress on an annual basis, and actual transitions can occur over much longer time frames.

Work in progress

The STM provides an example of an ecological process model that represents current knowledge and belief about the dynamics of woodland ecosystems within the Goulburn Broken catchment, and how these woodlands do (or might) respond to management. We have attempted to tailor this model so that it is suitable for adaptive management, whereby it can be used as a tool for assessing and learning about the response of a system to management. And this approach also facilitates a logical way to report on changes in vegetation condition.

State and transition models offer a simple, widely familiar and realistic framework, and we are confident that with further development that this example in the Goulburn Broken will serve as an important example of applying adaptive management to help restore native vegetation. Not surprisingly, there are some important steps to take before this approach can be held up as an example of working success, but we’ve already demonstrated its potential to a range of stakeholders.

If you’re interested in management experiments of this type, contact me and I’ll send you a copy of our technical report. And watch this space...

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References


This project was a collaborative venture between the the Applied Environmental Decision Analysis and Landscape Logic CERF hubs, the Goulburn-Broken Catchment Management Authority and The University of Melbourne. We will continue this work over the next 3 years with our Partners (GBCMA, DSE and DECCW), supported by an ARC Linkage grant. For more background on the use of adaptive management by Catchment Management Authorities see Decision Point #20.
The unique nature of the Kimberley, one of Australia’s most significant ecological assets, is under threat. Scientists have put forward a list of key landscape management actions to best deal with it. The report, which was published in February, goes beyond listing threats to important ecological assets, to providing costings and options for preserving Kimberley’s wildlife. For the first time, the consequences of decisions in response to species declines, as far as Kimberley wildlife is concerned, are clearly on the table.

The Kimberley is a special place; a unique ecological and cultural landscape that has been shaped over millennia (see box on an ancient and contemporary landscape). It’s a biodiversity hotspot containing some 65 endemic vertebrates including the tiny Monjon rock wallaby, the striking Kimberley rock monitor, and the recently discovered chattering rock frog. It’s also the last refuge for critical weight range mammals like the golden bandicoot and the golden-backed tree rat, which have been lost over much of their former range (critical weight range mammals weigh between 35 to 5500 g and are judged as being most vulnerable to extinction in Australia). Perhaps most striking is that the north Kimberley is the only place left on mainland Australia with an intact vertebrate fauna; all other regions have suffered an extinction of at least one mammal.

But, unfortunately, things are changing for wildlife in the Kimberley. Alarming declines of native plants and animals occurring across northern Australia are now striking the Kimberley (Woinarski et al 2011). These declines can be primarily attributed to existing (and interacting) threats including inappropriate fire and grazing regimes, invasive weeds and feral cats. If such pressures are left unchecked, the Kimberley will likely face dozens of losses of wildlife species.

It’s not that the region is considered unimportant by the authorities. The Kimberley is now a national priority for biodiversity conservation by both state and federal governments as well as many NGOs. Approximately 11% of the Kimberley is currently protected for conservation in protected areas with further areas being proposed for additional national parks and Indigenous protected areas. However, it is widely recognised that existing funds for managing the threats to Kimberley’s biodiversity are vastly insufficient, both within and outside of protected areas.

“The approach we’ve used should help ground conservation investment in the region in a defensible and rigorous framework”
An ancient & contemporary landscape

Lying in Australia’s northwest corner, the Kimberley is an ancient landscape that has been shaped by wind and water over millions of years. It’s largely covered in savanna, dotted by boab trees and dissected by mountain ranges, gorges and valleys hiding pockets of rainforest. The Kimberley hosts a rich and diverse assemblage of plants and animals, many of which are found nowhere else in Australia, or indeed the world, making this region one of the most ecologically precious on earth.

Indigenous Australians have inhabited the Kimberley for tens of thousands of years and it remains an important region for contemporary Aboriginal culture. European exploration in 1879 led to pastoral development and grazing which has become the predominant use of land in the region. The Kimberley is famous for the thriving pearl industries of Broome, the distinctive pink diamonds of Kununurra and its growing popularity as a tourist destination. Despite the region’s activities and diversity, its relative remoteness has protected it from the scale of habitat loss and degradation experienced by many other parts of Australia.

Priorities for Kimberley’s wildlife

(Continued from page 7)

about it an analysis was needed that explicitly stated what was likely to be achieved with different levels of funding and effort (as well as what was likely to be lost if these levels of resources were not available).

And so the project ‘Priority threat management to protect Kimberley wildlife’ was born. Its authors hail from CSIRO, The Wilderness Society, Australian Wildlife Conservancy, University of Queensland (AEDA/CEED) and The Australian National University. The project aims to compare the cost-effectiveness of different management actions, and to identify the set of management actions and the funding required to keep functioning populations of all wildlife in the region. The authors recognise that countless invertebrates and plants are also threatened in the Kimberley, but vertebrates were the focus due to their social value and the availability of data and knowledge.

The stripe-faced dunnart is one of the species predicted to be benefited by effective management of fire, herbivores and feral cats. (Image by Steve Murphy/Australian Wildlife Conservancy)

"The information provided by this project will be useful for prioritising funds for conservation management in the Kimberley,” says Josie Carwardine, lead author of the report. “And the approach we’ve used should help ground conservation investment in the region in a defensible and rigorous framework.

“We haven’t been able to include every important aspect of biodiversity, nor information on all of the priorities of people in the Kimberley. But it’s a transparent process and anyone who possesses additional or different information on the threats or outcomes of management actions can incorporate them into the framework and generate their own results.”

Threat and response

The approach used by the team of investigators was similar to the PMSEIC report (Possingham 2002), combining existing data with the knowledge of experts in ecology and land management to identify and appraise conservation management actions. The use of expert knowledge was necessary because the pool of scientific data on species distributions and the impacts of threatening processes is poor, and there is an urgent need for conservation action. Expert information was collected at two expert workshops with many follow-up consultations.

The key threat management actions identified by the experts were: 1) combined management of fire and introduced herbivores, 2) eradication, control, and quarantine of weeds and 3) control of introduced predators, particularly feral cats. For each action, in each of the Kimberley’s five bioregions, they estimated costs over a 20 year period, feasibility of implementation (from 0-100%) over various land tenures and the probabilities of functional persistence in the landscape over 20 years (hereafter probability of persistence) of Kimberley wildlife species with and without the action taking place. The authors used this information to estimate losses of vertebrate species if funding remains inadequate, the financial costs and actions required to avoid these losses and the likely outcomes per dollar spent on each of these actions in each bioregion.

"It’s a transparent process and anyone who possesses additional or different information on the threats or outcomes of management actions can incorporate them into the framework and generate their own results.”
The key scientific findings of the report are:

- **Without effective investment in the management actions identified, 45 species of wildlife are likely to be functionally lost from the Kimberley in the next 20 years.** This includes mammal species endemic to the region such as scaly-tailed possum (Wyulda) and Monjon rock wallaby, as well as threatened species that have already disappeared from other parts of northern Australia and for which the Kimberley is their last refuge (eg, golden-backed tree-rat and golden bandicoot). Without effective management many other species would be at risk of declines, including seed-eating birds such as the Gouldian finch, carnivorous reptiles such as the spotted tree monitor and small mammals such as the western chestnut mouse.

- **The wildlife of the Kimberley is likely to be secured with an initial and immediate investment of $95 million, followed by an ongoing investment of $40 million per annum, directed towards the key management actions and safeguarding populations of highly sensitive species in cat-free sanctuaries (some eight species with lower persistence probabilities across landscapes will need protection on islands and fenced areas on the mainland). Assuming this is spent effectively, this equates to less than $1 million annually per species saved from likely loss and creates a high likelihood of securing Kimberley wildlife species. Activities that enable conservation management, such as planning across social groups, large scale cooperation and establishing conservation areas, would cost additional funds.

- **Current annual investments in conservation management would need to be at least doubled, and spent optimally and effectively, to secure the Kimberley’s wildlife species.** A sum of approximately $20 million per year is currently spent on conservation management by a variety of existing organisations working in the Kimberley and its islands. According to the analysis, even if this amount were spent optimally and effectively on the mainland-based actions as recommended, it would be insufficient to avoid the likely functional loss of 31 wildlife species from the region.

- **Actions vary in terms of their cost-effectiveness.** The single most cost-effective management action would be to reduce the impacts from feral cats (at $500,000 per bioregion per year) with a combination of education, research and the cessation of dingo baiting, however feasibility of success is low. The next most cost-effective action is to manage fire and introduced herbivores (at $2–7 million per bioregion per year); this action is highly feasible and, if implemented effectively, would generate large improvements in probabilities of persistence for almost all wildlife species.

- **Investment in the actions we identified has vast potential to provide benefits outside wildlife conservation, such as improved persistence of plants and invertebrates, carbon benefits, conservation of Indigenous knowledge, enhanced livelihoods for people in the region, soil and water conservation.**

The authors note that successful implementation of the key actions will require an appropriate alignment of conservation goals and other aspirations and priorities of the Kimberley community. Further efforts are required to support discussions, careful and local negotiations and planning with Kimberley residents and land-users, particularly traditional owners, pastoralists and the tourism industry. Other important activities for assisting the successful implementation of wildlife conservation actions include support of the Indigenous Protected Areas program, negotiating stewardship programs and other incentive schemes with pastoralists, and policy reform – some of which are under negotiation or underway.

“Our report provides priority threat management actions to avoid the loss of 45 wildlife species from the Kimberley,” says Tara Martin, report co-author. “If action isn’t taken we have explicitly stated what we stand to lose.”


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*The WildCountry Science Council is a group of eminent ecological scientists from Australia and abroad established to provide independent advice to The Wilderness Society (TWS) about protecting and restoring biodiversity in Australia.*
If today’s rate of warming continues we are likely to witness a serious climate-induced decline in the world’s biodiversity during this century. While protected areas have played a key role in safeguarding biodiversity from habitat loss, there is a growing concern that the future effectiveness of protected areas will be undermined by the impacts of climate change. Despite the science indicating that climate change is a major emerging threat to biodiversity, there are no existing prioritisation schemes for conservation at the global scale that consider the possible impacts of climate change. Why? Basically because it’s extremely difficult to formulate such a scheme using existing approaches that seek to deal with the impacts of climate change.

Methods for incorporating climate change into conservation planning have been developed for regional-scale planning. The majority of these approaches are based on the prediction of shifts in species range and use correlative species distribution models which predict species ranges using occurrence or abundance data and environmental variables. However, overcoming differences among model predictions and discrepancies between fundamental and realised niches usually requires detailed data on species migration rates, interspecies interactions, and rates of adaptation. The value of conservation prioritisation based on future species ranges remains limited by our ability to compile and analyse these data for thousands of species over large spatial scales.

So, is there another way of approaching the challenge? We think there is, and have proposed a novel approach to allocating conservation resources under a changing climate at the global scale that is based on the notion of climate stability. It’s an approach that doesn’t require the (uncertain) information on future species range shifts. Rather it considers areas where the climate is expected to be most stable (see figure 1).

Using climate stability information we modelled possible conservation funding allocations among the world’s ecoregions to achieve highest biodiversity persistence for 6,777 terrestrial vertebrate endemic species. The proportion of each ecoregion potentially affected by future climate change was used to infer the potential impact of climate change. We then used a dynamic resource allocation algorithm to prioritise conservation investments. The problem the algorithm solves is to minimise species loss by reducing the expected negative impact of climate change and land conversion on vertebrate species, constrained by a fixed budget and accounting for the area already protected or developed.

We allocated investments under two resource allocation scenarios: a climate-adapted allocation and a climate-neutral allocation. In the climate-adapted allocation, the algorithm discounts the expected benefit of investing in an ecoregion by the probability that the invested area...
is affected by future climate change, thereby giving increased value to ecoregions that are predicted to remain ecologically stable in the face of climate change. This probability is set to zero across all the ecoregions in the climate-neutral allocation. We then measured how the allocation of funds shifted in space and time by incorporating the predicted negative effects of a changing climate.

Figure 2 shows the relative differences in the climatic stabilities among 791 terrestrial ecoregions. You can see that there is substantial spatial variation in the predicted climatic stability. The ecoregions of high stability largely overlap with the areas known for their high biodiversity. These areas include the Andes, tropical savannas in Africa, Madagascar, islands in South East Asia (Borneo, Java, and Sulawesi), New Guinea, the western coast of the Indian subcontinent, and the subtropical forests of the east coast of Australia, where the climatic stabilities are more than 80%. The areas with less stability are found in north and middle-western North America, the west of Amazon basin, Siberia, Himalayas, and the tropical savannah and desert regions of Australia.

Figure 3: Differences in the total investment under the climate-adapted and climate-neutral allocations. Percentage changes in investment within an ecoregion is presented. Warm colours (yellow and red) represent the ecoregions that receive increased investment under climate-allocation. Cold colours (pale blue and dark blue) represent the ecoregions with decreased investment.

Under our climate-adapted allocation, ecoregions that received increased investment reflect their stable climatic conditions (Figure 3). In the Americas, for instance, investment shifted from arid ecoregions such as the dry forests in northern Mexico to wetter ecoregions such as Central Andean Wet Puna. This shift is supported by a general trend in which arid areas are considered to be particularly sensitive to the negative impacts of climate change. Borneo, Sulawesi, and New Guinea all received increased funding in our climate-adapted allocation, which reflects the general view that the social factors (e.g. rapid land clearing) is the major threats in these areas while its climate remain relatively stable. Our approach also suggests reducing investment in the Himalayas, an area which will experience severe negative impacts from climate change.

Adapting our investments in protected areas to account for the future impacts of climate change ensures a more robust reserve network. In our scenario, we found that less area and fewer species will be lost from newly established protected areas by preferentially investing in climatically stable areas. Importantly, our modelling predicts that 22% more species remain within new protected areas in the climate-adapted allocation. Choosing to invest in areas with high climatic stability, therefore, will ensure that our protected areas remain effective at conserving species in the face of climate change.

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Reference

**Smiley energy choices**

A Californian electricity company began issuing bills that showed the customer’s monthly energy consumption in comparison with the average use of their neighbors, as well as with the average of the most efficient customers. Their aim was to reduce energy consumption. Those customers whose consumption was lower than the average received images of smiley faces on their bills, while those who consumed more received frowny faces.

The result? First, people complained about getting frowny faces (and the company quickly stopped sending them). Second, the campaign worked. Customers who received the new bills conserved significantly more energy than those who didn’t. Indeed, they conserved more than when they were offered rebates on installing energy-saving appliances. The campaign was so successful that it has now spread to several other major cities in the US.

Why did this work? Sometimes we respond to rational thought. But we also respond to shame, competition, gratitude and fear. We all want to be above average, and we especially want to do a bit better than the neighbours!

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**Decision Point** is written and produced by David Salt. If you have news or views relating to CEED or of interest to CEED members, please send them to David at David.Salt@anu.edu.au

When we print out **Decision Point** we use recycled paper. We hope you will too.

**What’s the point?**

**The Future of Sharks: A Review of Action and Inaction**

This report uses fisheries information provided to the UN FAO to identify the top 20 shark-catching countries and other entities, and then assesses whether they have taken the management and conservation measures they agreed to in 2001.


**The gaps in Marine Protected Areas**

Although a total of 1.3 per cent of global marine areas is currently within Marine Protection Areas (MPAs), this is far from the Convention of Biodiversity’s (CBD) 10 per cent target.