DECISION POINT

Connecting conservation policy makers, researchers and practitioners

Issue #83 / October 2014

Conservation on reserve

Can national parks save our threatened species?

Christmas Island National Park under threat

How much money will save biodiversity?

Using focal species to design reserve networks

Decision Point

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

Plus

DECISION POINT

Issue #83 / October 2014

Contents



The Christmas Island giant gecko is in trouble. It's cousins, the forest skink and coastal skink, are also threatened along with a host of other animals on Christmas Island. Find out what the problem is and how one PhD student hopes to make a difference in our story on page 8. (Photo by Jason Turl)

On the point

On reserve

Got a bit of nature you want protected? No probs; whack a national park around it.

Would that it were that simple. In the real world land is expensive, budgets are limited and natural values are seldom clearly defined. Everyone wants nature protected but drawing up a national park that meets everyone's objectives (environmental, economic and social) is a major challenge. This issue of Decision Point explores many of the dimensions of that challenge.

Up front is a discussion on what's happening on the international scene as the world's nations agree on a target for expanding the protected area network. The goal is to increase it from 13% to 17% of land area by 2020, a very significant increase. Unfortunately, as Oscar Venter and colleagues discovered when they did the numbers, if the extra land added is the cheapest on offer (the business-as-usual approach) little will be achieved in terms of protection for our threatened species (see page 4).

On page 6, Megan Barnes uses bird lists to evaluate the effectiveness of Australia's Wet Tropics. Emily Nicholson tests whether focal species can help in reserve design (page 10). James Watson sets out how little of our important primary forests are protected by our reserve system (page 11). And on page 11 Duan Biggs discusses how nature-based tourism is an integral part of conservation in South Africa's National Parks.

We also reflect on how EDG research has contributed to conservation outcomes in Parks Australia (page 12) and Melissa Wynn describes the problems faced by a suite of threatened species in Christmas Island's National Park (page 8).

But say, just for a moment, money was available to set up a national park to provide adequate protection to all threatened animals. How much money would we need? The answer is 42 (as in $42 billion, see page 5). Which may finally solve that enduring mystery posed by Douglas Adams who told us the answer to the ultimate question of life, the universe and everything is 42 (but never told us what the actual question was).

David Salt
Editor
Decision Point

DECISION POINT

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

Decision Point is available free from: http://www.decision-point.com.au/

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

Conservation through anthromes

Many have argued that biodiversity conservation must be extended to environments that humans have shaped directly. Yet popular biogeographical frameworks such as biomes do not incorporate human land use, thereby limiting their relevance to future conservation planning. 'Anthromes' (anthropogenic biomes) map global ecological patterns created by sustained direct human interactions with ecosystems. In this paper the researchers set out to understand how current conservation efforts are distributed across anthromes.

They analysed the global distribution of IUCN protected areas and biodiversity hotspots by anthrome. They related this information to density of native plant species and density of previous ecological studies. Potential conservation opportunities in anthromes were then identified through global analysis and two case studies.

Protected areas and biodiversity hotspots are not distributed equally across anthromes. Less populated anthromes contain a greater proportion of protected areas. The fewest hotspots are found within densely settled anthromes and wildlands, which occur at the two extremes of human population density. Opportunities for representative protection, prioritization, study and inclusion of native species were not congruent.

Based on this analyais, they suggest that researchers and practitioners can use the anthromes framework to analyse the distribution of conservation practices at the global and regional scale. Like biomes, anthromes could also be used to set future conservation priorities. Conservation goals in areas shaped by humans need not be less ambitious than those in 'natural areas'.

Reference

Martin LJ, JE Quinn, EC Ellis, MR Shaw, MA Dorning, LM Hallett, NE Heller, RJ Hobbs, CE Kraft, E Law, NL Michel, MP Perring, PD Shirey and R Wiederholt (2014). Conservation opportunities across the world's anthromes. *Diversity and Distributions* 20:745-755.
http://onlinelibrary.wiley.com/doi/10.1111/ddi.12220/abstract;jsessionid=88C675414D9BCCCED0E7D661DF930D77.f03t04

Who uses urban parks (and why)

Studies of how urban green space are used have largely focused on the availability and ease of access to green space, suggesting that greater opportunities to experience such space will lead to increased use. However, a growing literature emphasizes the potential for an individual's nature orientation to affect their interaction with green space. The researchers in this study examined the importance of both opportunity and orientation in explaining urban park use.

An urban lifestyle survey was deployed across Brisbane to assess patterns of green space use. Participants (n = 1479) were asked to provide information on demographics, private yard use, park visitations in the past week, and their orientation toward nature. About 60% of those surveyed had visited a park in the past week, and while this park user population had significantly greater nearby park coverage (within a 250 m radius), a much stronger determinant of visitation was their higher nature orientation. This suggests that while both opportunity and orientation are important drivers for park visitation, nature orientation is the primary effect.

Park users also spent significantly more time in their yards than non-park users, suggesting that yard use does not necessarily compensate for lower park use. Park users with stronger nature orientation (i) spent more time in their yard, (ii) traveled further to green spaces, and (iii) made longer visits than park visitors with weaker nature orientation.

Overall, the results of this study suggest that measures to increase people's connection to nature could be more important than measures to increase urban green space availability if we want to encourage park visitation.

Reference

Lin BB, RA Fuller, R Bush, KJ Gaston and DF Shanahan (2014). Opportunity or Orientation? Who Uses Urban Parks and Why. *PLOS ONE*
http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0087422

Marine conservation planning across national borders

Explicitly including cost in marine conservation planning is essential for achieving feasible and efficient conservation outcomes. Sounds like common sense yet spatial priorities for marine conservation are still often based solely on biodiversity hotspots, species richness, and/or cumulative threat maps. This analysis aims to provide an approach for including cost when planning large-scale Marine Protected Area networks that span multiple countries. It was undertaken in the complex setting of the Mediterranean Sea.

In order to include cost in conservation prioritization, the researchers developed surrogates that account for revenue from multiple marine sectors: commercial fishing, noncommercial fishing, and aquaculture. Such revenue can translate into an opportunity cost for the implementation of an MPA network. Using the software Marxan, they set conservation targets to protect 10% of the distribution of 77 threatened marine species in the Mediterranean Sea. They compared nine scenarios of differing opportunity costs by calculating the area and cost required to meet our targets. They further compared their spatial priorities with those that are considered 'consensus areas' by several proposed prioritization schemes in the Mediterranean Sea, none of which explicitly considers cost.

The analysis found that for less than 10% of the Sea's area, the conservation targets can be achieved while incurring opportunity costs of less than 1%. They demonstrated that, in marine systems, area is a poor cost surrogate and that the most effective surrogates are those that account for multiple sectors or stakeholders. Furthermore, their results indicate that including cost can greatly influence the selection of spatial priorities for marine conservation of threatened species.

Although there are known limitations in multinational large-scale planning exercises, attempting to devise more systematic and rigorous planning methods is critical given that collaborative conservation action is on the rise and the global financial crisis has restricted conservation investments.

Reference

Mazor T, S Giakoumi, S Kark and HP Possingham (2014) Large-scale conservation planning in a multinational marine environment: cost matters. *Ecological Applications* 24: 1115–1130.
http://www.esajournals.org/doi/abs/10.1890/13-1249.1

New national parks and threatened species

Expanding the protected area network so it makes a difference

In 2010, 193 national signatories of the Convention on Biological Diversity (CBD) adopted a new strategic plan to tackle the continuing decline in biodiversity. Part of that plan included a set of targets (known as the Aichi Targets) and one of those targets (no. 11) involved an ambitious commitment to expand the global coverage of terrestrial protected areas from 13% to 17% by 2020. This is big! In terms of size this could drive the most rapid expansion of the global protected area network in history adding almost six million square kilometres of land! (in terms of area we're talking something in the order of 70 Tasmanias)!

On the face of it, that seems like a wonderful commitment that should go some way to securing a future for the world's threatened biodiversity. But does it? What are the options for achieving this expanded network and what biodiversity does it secure? According to a new analysis involving several EDG researchers, very little might be achieved if we take the 'business-as-usual' approach to expanding the network (Venter et al., 2014). Indeed, the take home message from their analysis is that future national park expansion should focus on land that is home to threatened species, rather than on land that is cheap to protect.

On threatened species

Protecting threatened species is another top priority of the CBD. Aichi target 12 aims to "prevent the extinction of all known threatened species and improve and sustain their conservation status." So how important is our network of protected areas to protecting threatened species, and what could be achieved as we grow the network? These were the very questions Oscar Venter and colleagues set out to answer. The first step in their analysis involved comparing the distributions of over 4,000 threatened species of birds, mammals and amphibians with the distribution of the world's protected area network to see how effective it is. Then they looked at options for expanding the network and analysed how much extra protection was afforded by each option.

So, how good is the existing network of reserves? In terms of threatened species, the existing system doesn't offer much protection at all. Only 15% of the threatened species examined are adequately covered by the existing network of reserves. Some 17% of threatened vertebrates are not found in a single protected area and 85% are not covered to the level considered to be adequate.

"Our study shows that existing protected areas are not doing their job effectively, leaving many species in a perilous position," says Oscar Venter. "This is because protected areas are often preferentially established in locations that are remote or have little agricultural value, failing to protect the imperiled biodiversity found on more valuable land."

"We're very good now at deciding what's useless for agriculture and, unfortunately, that's what dominates the global protected-area system – places that we can't plough up and turn into food," adds co-author Hugh Possingham.

Given this, the researchers believe it's even more important that land added to the network doesn't repeat the mistakes that have been made in the past – that is, growing the network as cheaply as possible without considering options that protect more threatened species.

Business as usual

"We found that if countries choose to expand their protected areas in a manner that minimizes agricultural opportunity cost, meeting their national-level targets for 17% coverage would entail a once-off transaction cost of US$0.9 billion and an annual agricultural opportunity cost of US$4.9 billion," says Venter. "As this option aligns with the previous pattern of protected area establishment, we view it as a likely business-as-usual scenario for meeting the Aichi target."

What does 'business as usual' get you if you achieve the 17% area target? According to Venter, it buys you adequate protection for around an extra 250 threatened species. This equals 21% of threatened vertebrates (or, in other words, it leave four out of five threatened species with inadequate protection) which really means it fails to meet the Aichi Target for threatened species.

Their analysis drives home the message that simply adding cheap land to the network is not a cost effective approach to protecting threatened species.

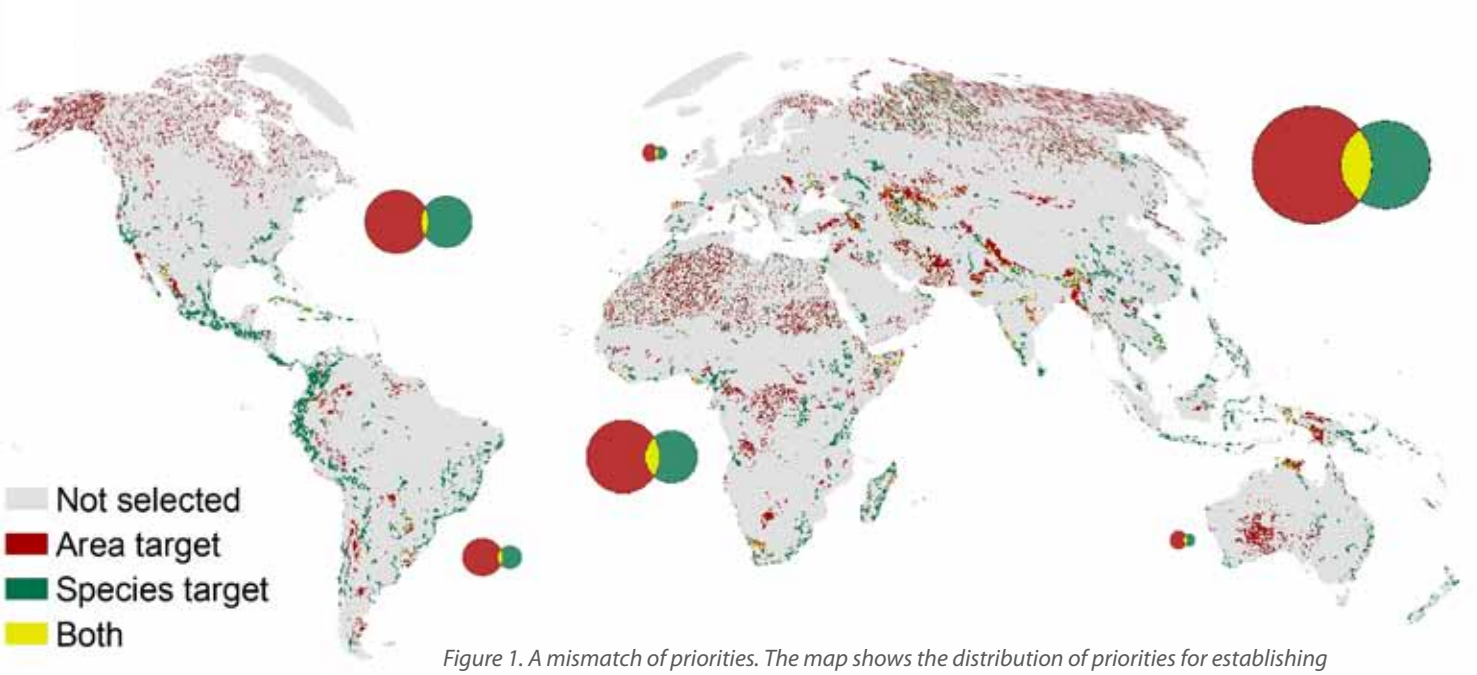


Figure 1. A mismatch of priorities. The map shows the distribution of priorities for establishing new protected areas to meet the 17% targets under Aichi Target 11. Red indicates protection at minimal cost and ignoring ecological representation. Green indicates protection that targets threatened species. Yellow indicates areas that are covered under both scenarios.

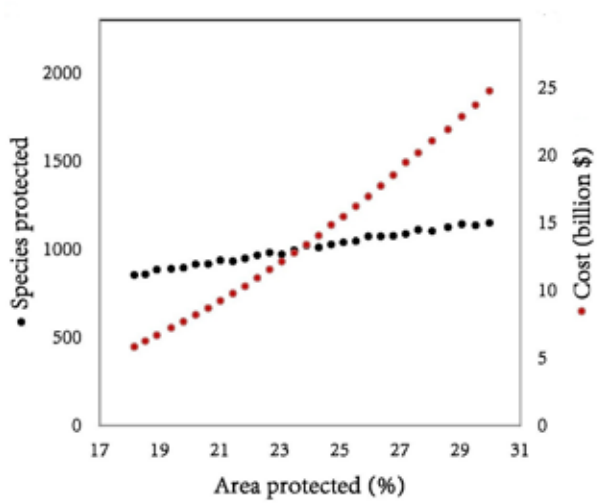


Figure 2. The number of globally threatened vertebrates that reach our adequacy targets (black), and the agricultural opportunity cost of establishing new protected areas (red), as the proportion of global land areas protected increases above 17%.

What happens if we make protecting threatened species the priority when selecting which land we'll add to the network?

"If protected areas are directed in a cost-efficient manner to protect threatened vertebrates, these species could be protected for an estimated agricultural opportunity cost of about US$42.5 billion annually," says Venter.

So, achieving 17% via the cheapest option (business as usual) costs around US$5 billion whereas securing land that protects 4,000 threatened vertebrates costs over US$40 billion, around eight times as much. Why the big difference?

"This difference in cost is driven by a low concordance between areas that are cheap to protect and those that capture the distributions of threatened species," explains Venter. "Land selected for threatened species tends to align with tropical forest hotspots, such as the tropical Andes and eastern Madagascar, whereas the cheapest land to protect is remote and often in more arid zones. This lack of overlap helps explain why the existing protected area network, which has favored low-cost areas in each country, represents threatened species rather poorly."

A middle ground

But the analysis also clearly demonstrates a non-linear relationship between increasing protection for threatened species and extra land added to the network (see fig 3). They identified a middle ground where close to half of the threatened species are adequately protected at just 1.5 times the cost of business-as-usual (a cost of US$ 7.4 billion annually). In other words, for a little extra money over and above the cheapest option, a vast increase in protection to threatened species can be gained.

"Nations are clearly making a choice to go 'cheap and nasty', because of avoided opportunity costs," says James Watson, a co-author on the study. "Our point is it's not that expensive, really. That's a great victory for conservation for not much more cost."

"Exploiting this opportunity will require directly linking the CBD targets on protected areas and threatened species, thereby formalizing the interdependence of these key commitments."

The CBD and the Aichi Targets

Biodiversity around the world has undergone dramatic declines over the last century. In response to this, the Convention on Biological Diversity (CBD) was signed in the 1990s by 168 countries, including Australia. Each country committed itself to bringing about a significant reduction in the rate of loss of biodiversity by 2010. A range of indicators reveals the global community comprehensively failed to meet this goal (see *Decision Point #43*).

At the tenth meeting of the Conference of the Parties, held in Nagoya in 2010, a new set of twenty targets was adopted. These are known as the Aichi Targets (Nagoya is located in Japan's Aichi Prefecture) and they aim to produce more concrete results.

The key then in expanding the area of the global network of protected areas for maximum effect is to tie it to the goal of protecting threatened species.

"Our analyses clearly demonstrate that considerable increases in protected area coverage of species could be achieved at minimal additional cost," says Venter. "Exploiting this opportunity will require directly linking the CBD targets on protected areas and threatened species, thereby formalizing the interdependence of these key commitments."

"By protecting wild areas and threatened species, we can greatly increase the chances of maintaining Earth's biological diversity for future generations," says Watson. "When these goals are combined, countries are much more likely to create new parks in biologically threatened areas, which will lead to long-term dividends for global conservation."

More info: Oscar Venter oventer@uq.edu.au

Reference

Venter O, RA Fuller, DB Segan, J Carwardine, T Brooks, SH Butchart, M Di Marco, T Iwamura, L Joseph, D O'Grady, HP Possingham, C Rondinini, RJ Smith, M Venter & JEM Watson (2014). Targeting Global Protected Area Expansion for Imperiled Biodiversity. *PLoS Biol* 12(6): e1001891. doi:10.1371/journal.pbio.1001891 http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1001891

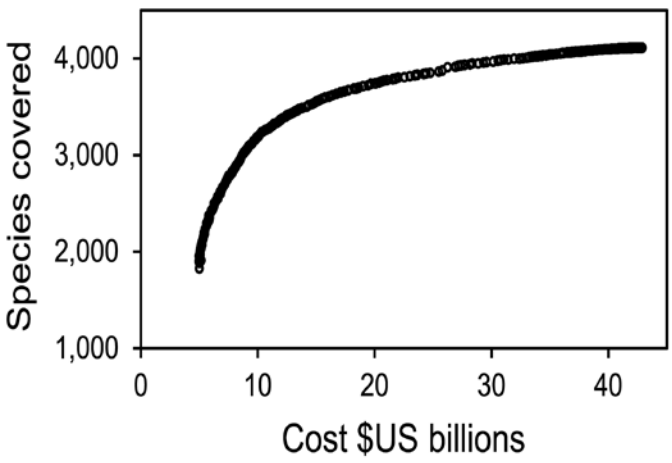


Figure 3. Efficiency frontier between the cost of establishing additional protected areas to achieve 17% coverage and the number of species covered. The y-axis presents the proportion of each species adequacy target that is met within protected areas..

Citizen science and the value of protected areas

A bird on the list is worth how many in the bush?

By Megan Barnes (University of Queensland)

Protected areas underpin many global conservation efforts, but do they work? Despite significant investment in protected area networks, it is often unclear whether national parks and other protected areas are effective in maintaining their biodiversity values. Long-term monitoring data are critical for determining whether protected areas are able to achieve their objectives. The problem is that in most cases, these long-term data 'officially' do not exist. The good news is that even though 'official' data sets collected by scientists often don't exist, 'unofficial' observations made by keen 'amateur' naturalists are sometimes readily available. Can these citizen-science records shed any light on the effectiveness of protected areas? We examined the value of bird lists in assessing impact in Australia's Wet Tropics and found they can make a real contribution (Barnes et al., in press).

Evaluating impact

'Impact' is the difference in the total value of an asset caused by an action. It can also be thought of as return on investment.

In the case of protected areas and biodiversity values, impact is the difference in the state of the biodiversity value that can be attributed to the protected area and any management therein. To evaluate impact, we need to compare change in the protected areas to the change that would have occurred in the value in the absence of the protected area.

Ideally, protected area performance would be quantified using a standardised BACI (Before-After-Control-Impact) monitoring program that includes a number of control regions. The problem is that 'protection' has usually been established well before resources are dedicated to biological monitoring. Such data are therefore rarely available from standard monitoring programs.

Citizen data

So if 'official' data is lacking, are there any other data around that might be of use? As it happens, places of high natural value are often a magnet for nature lovers, especially birdwatchers. And birdwatchers are good list makers – meaning that many places for which there are no official data have an abundance of unofficial data in the form of bird lists.

Not only are there often many bird lists available for some areas, they are often the only source available if we go back a couple of decades.

Previously, ecologists have treated citizen-collected scientific data with some reservation. Part of this is based on the reliability of observations made by amateur naturalists and the non-standard nature in which the data are recorded. However, it turns out the data that bird nerds painstakingly enter and share for the pure love of birds, can be incredibly valuable!

What's on the list?

The aim of our analysis was to evaluate the contribution of protected areas to the conservation of endemic birds. We did this by comparing abundance and trends in birds within and outside of protected areas in the Australian Wet Tropics in Queensland. Our data were non-standardised volunteer collected bird surveys (bird lists) and the approach we used involved List Length Analysis. Similar to other studies (Szabo et al., 2010) we estimated trends in species populations with a Bayesian logistic regression to infer bird presence from bird lists.

List Length Analysis uses presence-only data and assumes that the length of a species list is a reasonable measure of how likely any bird is to be found. In theory, if a species is declining, its relative abundance compared to that of other species within the community will also decline, and therefore a greater amount of effort is required to find it. Hence, if a species is declining, it will appear less frequently on bird lists of the same length as time passes.

Bird lists compiled by 'citizens' may inform the effectiveness of our reserve networks. (Photo by Dirk Hovorka)

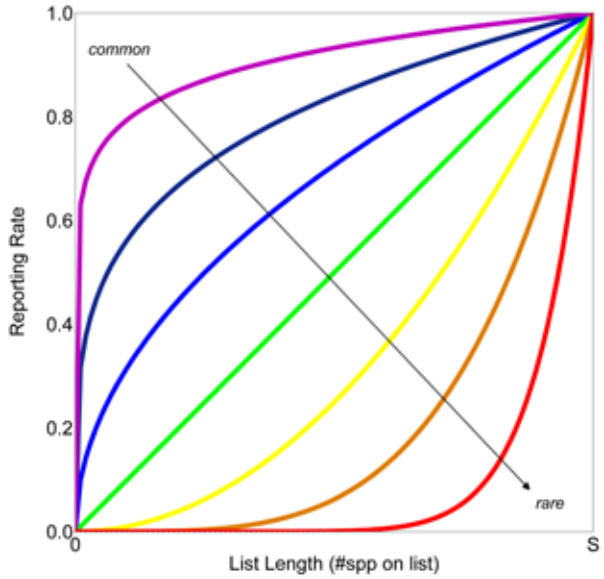
By adapting List Length Analysis for impact evaluation, where formal data collection is too expensive or time consuming, it may still be possible to inform decision-making if citizen-collected species list data are available. This has exciting implications for places where there are lots of bird nerds but limited funds for surveying – like, for instance, the Brazilian Atlantic Forest.

Our analysis

Our analysis targeted 21 bird focal species. Overall, we found that 18 of these have been stable since 1998. Sixteen were more likely to be found within the Wet Tropic protected areas, two were more likely to be recorded outside, and three showed little difference. Except for one endemic species, there was no difference in trends in prevalence between protected and unprotected areas. These results suggest that for the majority of species, protected areas may contain better habitat than unprotected areas, but birds inside protected areas are not significantly better off through time than birds outside protected areas, as long as forest outside protected areas remains intact.

Substantial portions of the Wet Tropics were adversely affected by two severe tropical cyclones during the study period, and resultant local

The satin bowerbird is one species in the Wet Tropics World Heritage Area which would benefit from more targeted monitoring. (Photo by Dirk Hovorka)



Species lists can theoretically range from as short as zero (nothing seen at all) to as long as 'S', the total number of species in the region. We expect very common birds (purple [upper] line) to have high reporting rates – and will appear frequently on lists – even if we've made little effort and the lists have few other species on them. Similarly, rare birds (red [lower] line) will on average show up only after considerable search effort is expended – ie, on lists that are very long (have filled up with more common species). When a common species declines in relative abundance, we'd expect its reporting-rate/list-length relationship to approach that of a rarer species (arrow). In other words, if a species is declining, it will appear less frequently on bird lists of the same length as time passes.

declines have been reported for some of the species assessed (notably golden and tooth-billed bowerbirds). Though the confidence intervals for these species are broad, it is promising that sharp declines have not been noted, especially for golden bowerbirds, which also are among the most vulnerable species in the Wet Tropics under climate change. Further, given dire predictions for a number of Wet Tropics endemic species in the face of climate change, it is good to know that no major declines are yet evident overall!

Management implications

Our findings have direct implications for the monitoring and management of the Wet Tropics World Heritage Area and other landscape-scale management approaches. Since there is no marginal benefit of protected areas, our results potentially reflect the effectiveness of landscape management. Maintaining intact rainforest may be enough to ensure the conservation of viable populations of range-restricted birds in the Queensland wet tropics in the medium term! We would however recommend targeting more systematic monitoring towards species with high uncertainty, small sample size, indicated declines and differences between protected and unprotected areas. These include the golden bowerbird, fernwren, Atherton scrubwren, and satin bowerbird.

If the persistence of birds in Australia can be achieved with simple protection of habitat, Category I – IV protected areas are therefore likely to become more important: legally, they are currently the only areas in Australia that are protected from mining and logging in perpetuity (Nature Conservation Act 1992, Qld), at least in most jurisdictions.

Unfortunately, recent relaxation of land clearing laws (see http://concernedqldscientists.wordpress.com/) that were intended to prevent broad-scale vegetation clearing in Queensland are likely to result in increased land use conversion, so the actions of the WTMA and local landholders to continue their good work in the face of these challenges will be vital.

Want to try it?

We have developed an R package (the beta version is freely available online: http://www.edg.org.au/free-tools/listlength.html), along with a guide that explains how to get your data in shape, what you will need to undertake, and how to use the package. We're happy to help too, so let us know if you have any questions.

What's in a list?

At a minimum, a list contains the names of observed species, the date and a geographic location of the observations. Date can be an exact day or just the year in case of long term datasets. Similarly, geographic location can be broad if we are looking at the 'big picture'. However, if people have been making lists of the same group of species (as in bird lists) for the same place over a long time, those simple lists can provide us with a lot of valuable information.

The impact of these observations on our understanding of bird trends and behaviours, for example, can be massive, and only likely to increase in the future.

And, when it comes to bird lists, these days there are heaps of tools and organisations to help you maintain and share your list. In terms of Australia, check out Eremaea eBird

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

More info: Megan Barnes megan.barnes@uq.edu.au

Reference

Barnes M, JK Szabo, WK Morris & H Possingham (In Press). Evaluating protected area effectiveness using bird lists in the Australian Wet Tropics. *Diversity and Distributions*.

Szabo J, P Vesk, P Baxter & HP Possingham (2010). Regional avian species declines estimated from volunteer-collected long-term data using List Length Analysis. *Ecological Applications* 20: 2157–2169.
And see *Decision Point #38*

Saving reptiles on Christmas Island

Where do you begin?

By Melissa Wynn (The Australian National University)

They call it 'the Galapagos of the Indian Ocean', where golden bosun-birds soar over terraced limestone cliffs and the rainforest floor teems with millions of crabs – Christmas Island is truly like nowhere else in the world. But the island's highly endemic fauna is under pressure. Four species of mammal have gone extinct since human settlement, including the presumed recent loss in 2012 of the endemic pipistrelle bat (see Decision Point #60). And it's not just the mammals that have suffered. Since 1980, Christmas Island has also witnessed catastrophic declines in reptile numbers, with five of the six native reptiles currently on the verge of extinction.

Reptiles under threat

It is likely that three species, the critically endangered forest skink, (*Emoia nativitatis*), the vulnerable blind-snake, (*Ramphotyphlops exocoeti*), and the native coastal skink, (*Emoia atrocostata*) may already be extinct, however a captive breeding program has been set up for the Lister's gecko (*Lepidodactylus listeri*) and blue-tailed skink (*Cryptoblepharus egeriae*). It's hoped that these critically-endangered species in this program may avoid extinction through successful reintroductions in the future (Smith et al., 2012). The sixth species, the endangered Christmas Island giant gecko (*Cyrtodactylus sadleiri*) had declined by 30% by 2008, and although reduced populations remain, it is the last remaining reptile found in the wild.

Taken together, this is believed to be one of the largest reptile decline problems that Australia has ever faced.

The causes of these reptile declines are unknown, but the accidental introduction of invasive species has had devastating effects on many Christmas Island animals. Park managers on Christmas Island suspect

> "By developing a strategic, decision-making framework, this research not only aims to prevent the extinction of five endemic Australian reptile species, but also to develop an adaptive framework to cost-effectively manage and conserve other threatened island fauna."

The Christmas Island giant gecko (pictured above) is the last remaining endemic reptile recorded often in the wild on Christmas Island (and is in decline). It's believed the forest skink, the vulnerable blind-snake and the native coastal skink, may already be extinct whereas Lister's gecko and the blue-tailed skink live on only as captive populations. Big challenges lie ahead for managers of the Christmas Island National Park. (Photo by Jason Turl)

that the reptile declines have resulted from combined pressures from a range of invasive species, including cats, rats and yellow crazy ants. But two other highly invasive species: the Indian wolf snake (*Lycodon capucinus*) and the giant centipede (*Scolopendra subspinipes*), have filled the island's vacant ecological niche of 'small-reptile predator' with potentially devastating consequences for the endemic reptiles of Christmas Island which have no experience with such predators (introduced wolf snakes on the Indian Ocean island of Mauritius have had catastrophic impacts on the native reptiles there). However, unlike cats, rats and crazy ants, no control or eradication strategies currently exist for wolf snakes or centipedes, and management actions are yet to be implemented on Christmas Island.

What's an appropriate response?

There is no use investing money into conservation action on threatened species without an evidence base (knowledge of the

Christmas Island is also sometimes referred to as the 'kingdom of the crab' with armies of red crabs playing a major role in shaping the island's ecosystems. Like many other animals on the island, the red crab is also experiencing worrying declines. (Photo by Jason Turl)

Melissa Wynn gets up close with a destructive invader: the giant centipede. The centipede preys on small reptiles and is believed to be contributing to the decline of Christmas Island's native lizards.

species ecology, threatening processes and appropriate management strategies) suggesting the investment is likely to pay off. It has almost become accepted that predation is the principal cause of the endemic reptile declines on Christmas Island; but this hypothesis is far from being 'proved'. The lack of knowledge of key threats limits decision-making and management on the island, which in turn, prevents future reintroductions of the captive populations of Lister's geckos and blue-tailed skinks, currently breeding successfully both on the island and at Taronga Zoo.

Given catastrophic declines in all the other endemic reptile species on Christmas Island, we need to understand the key threats to the one reptile species that remains in the wild, the giant gecko, and the risk of further decline. This new knowledge is essential for designing management strategies to prevent further declines towards extinction.

My PhD research on Christmas Island aims to identify key threatening processes acting upon the endangered, endemic reptiles and develop ways to effectively target our investment in management to support future reintroductions and mitigate the risk of further decline in the Christmas Island giant gecko. This research strengthens existing links between EDG and Parks Australia (a division of the Australian Government's Department of the Environment) building on collaborations on Christmas Island and in other Commonwealth national parks. This new project on Christmas Island seeks to achieve a primary management objective outlined by Parks Australia: "Maintain or increase populations of significant native species" (Director of National Parks, 2014).

Informed decision making

This collaborative project bridges a critical gap between the research community and governmental departments, and will be one of the first to incorporate both robust decision-making methods and in-situ field experimentation to inform effective and targeted investment management. By developing a strategic, decision-making framework, this research not only aims to prevent the extinction of five endemic Australian reptile species, but also to develop an adaptive framework to cost-effectively manage and conserve other threatened island fauna.

When researching threatened or cryptic species, there is often a lack of empirical data available, and one has to rely on expert knowledge and experience gained in the field in order to make management decisions. Through mathematical models we are able to turn this knowledge into a quantifiable 'Value-of-Information' analysis which we can then use to guide decision-making and inform research priorities. Of course, these priorities will depend largely on money, and limited funding in both conservation research and environmental management means that informed decisions must be made carefully within the constraints of budgetary restrictions so that management actions get 'more bang for their buck'.

Currently I am working with experts from around the country to identify all the potential threats causing reptile declines on Christmas Island and to model the costs, benefits and constraints of all available management actions. These models will form a decision framework, identifying what new information would be of most value to inform research priorities in the field.

This strategic framework allows us to make informed decisions now, about how to effectively manage and conserve the rapidly declining reptiles on Christmas Island, and will provide leverage to guide effective and informed field experimentation within the constraints of limited resources, both on Christmas Island and on other threatened oceanic island communities.

The second component of my PhD will assess the value of information identified in the decision framework, and implement the highest priority research action in the field.

In the field

Fieldwork will occur on Christmas Island from September to March in the first two years of the project. We will use a combination of intensive mark-recapture studies (enhanced by VHF tracking and GIS analysis) to simultaneously monitor giant geckos and invasive species. We will be seeking to analyze: species distributions, mortality, demographics, behavioural interactions and temporal / spatial overlap.

We will also examine the gut contents of invasive predators in areas where these species coexist with giant geckos, to determine if predation is occurring (we will do this using a genetic approach available at the South Australian Museum). We hope to then develop effective trapping methods and baits for key predators. We will trial these control strategies to create predator-proof exclosures for future reintroductions of captive bred species.

This research, carried out in partnership with Parks Australia, and hopefully, with future support of international conservation organisations, will incorporate both robust decision-making methods and field experimentation to inform management and support the future reintroduction of critically endangered reptiles into Christmas Island National Park.

The hope is we can make a difference on Christmas Island. However, these efforts may also inform cost-effective management of threatened fauna on other islands around the world.

More info: Melissa Wynn melissa.wynn@anu.edu.au

References

Smith MJ, H Cogger, B Tiernan, D Maple, C Boland, F Napier, et al. (2012). An oceanic island reptile community under threat: the decline of reptiles on Christmas Island, Indian Ocean. *Herpetological Conservation and Biology*, 7, 206-218.

Director of National Parks (2014). *Christmas Island National Park Management Plan* 2014–2024. Commonwealth of Australia, ISBN: 978-0-9807460-3-7

Home away from home: a breeding centre containing captive populations of Lister's gecko and the blue-tailed skink. These critically-endangered species may not be extinct but there's little point in releasing them into the wild until we know what is destroying their populations.

Testing the focal species approach

Making conservation decisions using a subset of species

By Emily Nicholson (University of Melbourne)

When making conservation decisions, we never have all the information we need. For example, we don't know where all species are, nor do we know how they will react to changes to their environment. So, inevitably, we have to use a subset of species as proxies for how biodiversity as a whole will be affected by management. The question is: how do we go about selecting which species to use as proxies? And how does the method for selecting them affect the final conservation decision?

In the 1990s, Robert Lambeck proposed the use of a set of 'focal species' that are most affected by key threats. His and subsequent studies focused on selecting species to guide restoration or revegetation of native woodland. For example, to decide how connected or close together patches of bush targeted for restoration should be, you would be guided by the needs of the species that is most dispersal limited; to define the how big patches of habitat should be, you would be guided by the species that has the largest area requirements, such as the biggest home range.

The focal species approach is appealing because it is quite intuitive, but has faced a fair amount of criticism. First, there is a lack of evidence to support the underlying principle that focal species confer protection to co-occurring species facing similar threats; results from previous studies are ambiguous. Second, it is not clear what the objectives of management are. What sort of landscape are we aiming for, the best for each of the focal species, or for other species, or for all biodiversity? The landscape that is best for all species is impossible: species have different needs – the ideal landscape for one species will not be the best for another or for all other species.

Along with colleagues Hugh Possingham, Karin Frank and David Lindenmayer, I sought to understand the conditions under which the focal species concept has merit for making sound conservation decisions (Nicholson et al., 2013). Because the focal species concept is based on population processes and the persistence of species, both the objective and the responses of the focal species (and the other species they are supposed to represent) should be measured in terms of population viability, such as probability of persistence over a given time frame.

To test the focal species approach, scientists designed a reserve system based on the needs of a subset of vertebrates in the area: the bush rat (top, photo Museum of Victoria), has limited dispersal; the red-browed tree creeper (middle, photo David Cook), has the largest home range; and the mountain brushtail possum (bottom, photo Martin Cohen), has the lowest reproductive rate.

As a case study, we used a fragmented landscape of patches of native forest embedded in pine plantation near Tumut in NSW. David Lindenmayer has been working in this landscape for decades so we had a rich data set to draw from. We modelled ten species of vertebrates (four birds, five marsupials and a native rodent) representing a range of body sizes and life history strategies. We used a method for choosing a reserve system that maximizes the persistence of multiple species, where persistence is estimated using a metapopulation model, and is a function of the amount, quality and configuration of habitat patches and the ecology of the species.

Then we identified three focal species from the set of ten we had to choose from. The criteria for selection related to key model parameters for dispersal, size of home range and fecundity. We selected the bush rat, with limited dispersal; the red-browed tree creeper (a bird), as it had the largest home range of our ten study species; and the mountain brushtail possum, having the lowest reproductive rate. The question we then asked was this: does the reserve system that maximises the persistence of the three focal species also maximise the persistence of all ten species.

And what did we find? The best reserve system using the three focal species was the same as the best reserve system for all ten species. The focal species approach in this situation appears to work.

We also tested all 120 combinations of other three species sets from the ten species pool, and the only one that gave the ten-species reserve system was the focal species set. And the best reserve system was different to the optimum for any single species – it was a compromise between the needs of different species.

We don't claim that the best reserve system for the focal species represents the needs of all other species or other components of biodiversity. But it's the best we can make with the information we have, based on an explicit aim (in this case to maximise the persistence of a defined set of species).

So, not only have we tested the focal species approach and found that it can work, but we have also provided a framework for testing this and other methods for selecting proxies of biodiversity for decision-making.

The next step is to apply similar tests over many more case studies to find generalisations, and answer key questions such as: how many focal species are needed to make robust decisions? And how sensitive are our results to uncertainty in our information and the rules for their selection? Watch this (focal species) space.

> "We don't claim that the best reserve system for the focal species represents the needs of all other species or other components of biodiversity. But it's the best we can make with the information we have."

More info: Emily Nicholson emily.nicholson@unimelb.edu.au

For a longer version of this article see Emily's blog.

Reference

Nicholson E, DB Lindenmayer, K Frank & HP Possingham (2013). Testing the focal species approach to conservation planning for species persistence. *Diversity and Distributions* 19: 530–540. http://onlinelibrary.wiley.com/doi/10.1111/ddi.12066/abstract

Policy and the primary forest

Last chance to save a biodiversity cornerstone

There are forests and there are forests. All involve trees but some are more important than others when it comes to biodiversity and associated natural values. Primary forests are systems that are largely free from industrial-scale land uses, and spaces where natural processes still dominate. They provide maximum ecosystem benefits to humans and nature – and a new analysis suggests we need to act now if we are to save them.

Primary forests are critical for biodiversity conservation. Up to 57% of tropical forest species are dependent on old-growth forest habitat, and in the face of a rapidly changing climate they provide maximum natural adaptive capacity. And primary forests offer important refugia for many vulnerable species.

Intact forested watersheds generally result in higher quality water than other land covers (and alternative land uses) which increase sediment and generate up to 50% more water flow than regenerating forests. Primary forests are also the traditional home and territories of Indigenous peoples such as the Kayapo people of the Brazilian Amazon. Local people have strong incentive to preserve the forests they depend on as the basis of traditional subsistence uses including as a source of food, shelter and medicine.

New research led by Brendan Mackey of Griffith University and involving CEED researchers David Lindenmayer and James Watson and other colleagues from a variety of NGOs and universities, has shown how threatened primary forests are. Only one-quarter of primary forests now remain on Earth, with a mere 5% of this found in protected areas. Despite increasing global awareness, annual rates of primary forest loss remain as high as 2% in some countries.

Importantly, the study found that half of the world's primary forest are found in five developed countries (the U.S., Canada, Russia, Australia, and New Zealand). The time is ripe for these nations to show leadership and promote the conservation of remaining primary forests as an urgent matter of global concern. This is critically important in international negotiations (eg, the Convention on Biological Diversity, the UN Forum on Forests and the UN Framework Convention on Climate Change) as all fail to distinguish primary forests from industrial production forests, degraded forests, or even plantations.

The Great Western Woodland in Western Australia is one of the most floristically diverse areas in the world and a centre of plant endemism. It also located in a developed country underscoring the fact that primary forests are not just an issue for the developing world. (Photo by Amanda Keesing).

> "Only one-quarter of primary forests now remain on Earth, with a mere 5% of this found in protected areas."

A view of the Congo's primary forests from Nyungwe National Park, Rwanda. (Photo by Liana Joseph).

The authors identify four new actions that would provide a solid policy foundation for key international negotiations to help ensure primary forests persist into the 21st century:

1. **Recognise primary forests as a matter of global concern** within international negotiations and not just as a problem in developing nations;
2. **Incorporate primary forests into environmental accounting**, including the special contributions of their ecosystem services (including freshwater and watershed services), and use a science-based definition to distinguish primary forests;
3. **Prioritise the principle of avoided loss** – emphasise policies that seek to avoid any further biodiversity loss and emissions from primary forest deforestation and degradation;
4. **Universally accept the important role of indigenous and community conserved areas** – governments could use primary forest protection as a mechanism within multilateral environmental agreements to support sustainable livelihoods for the extensive populations of forest-dwelling peoples, especially traditional peoples, in developed and developing countries.

The world community needs policies that seek to avoid any further biodiversity loss and eliminate carbon emissions from primary forest deforestation and degradation. Failure to do so will open the flood gates to the looming agro-industrial juggernaut.

As the 21st Century unfolds, there will be a growing pressure for the expansion of agricultural land at the expense of forest ecosystems. Without the implementation of urgent policy interventions recommended here, we stand to lose the last large blocks of primary forest on the planet in the next few decades. That loss would be to the detriment of all life on Earth.

More info: James Watson jwatson@wcs.org

Reference

Mackey B, DA DellaSala, C Kormos, D Lindenmayer, N Kumpel, B Zimmerman, S Hugh, V Young, S Foley, K Arsenis & JEM Watson (2014). Policy Options for the World's Primary Forests in Multilateral Environmental Agreements. *Conservation Letters*. doi: 10.1111/conl.12120 http://onlinelibrary.wiley.com/doi/10.1111/conl.12120/abstract

The scientist and the Parks manager

Parks Australia and NERP ED

I spy an outcome

To highlight the many contributions our research is making towards conservation outcomes, Decision Point is running a series of short stories on what we have achieved. In this instalment the conservation outcome is the relationship itself. Parks Australia has engaged NERP ED on several challenges facing its natural resource management staff. NERP ED has provided information and techniques for dealing with them. Overarching this, however, has been a sharing of culture that has generated multiple collaborations and a greater confidence in the decisions being made.

During the past three years a productive working relationship has developed between the NERP Environmental Decisions Hub (NERP ED) and Parks Australia (a division of the Australian Government's Department of the Environment), capitalising on the research and communication skills of the hub and the on-ground management and knowledge base of the Parks Australia Natural Resource Management (NRM) staff.

The NERP ED has provided support for critical research and decision-support that has assisted Parks Australia to better manage Commonwealth reserves and contribute to global conservation efforts. Engagement with the NERP ED is supporting the adoption of improved park management practices and enabling confident and transparent communication of those practices.

The majority of the projects tackled collaboratively relate to management issues around threatened species, particularly cases where reasons for decline of a species are unclear. These projects have involved detailed discussion about the complex nature of decision making for threatened species management within a broader natural resource management framework, including the influence of widely varied and often interacting pressures and drivers of species and ecosystem persistence. Prioritisation of management responsibilities in the light of limited budgets is also an area of mutual interest. Of course, issues of uncertainty and limited resources are hallmarks of environmental decision making.

In November 2013, the NERP ED facilitated a two-day workshop with NRM managers from Parks Australia. The aim of the exercise was to help determine priorities to ensure effective management actions and to guide best-practice decision-making for the management of threatened species. The workshop brought together NRM managers from Commonwealth terrestrial reserves, as well as experts on the threatened flora and fauna. The workshop trialled a modified decision making tool. The tool assessed the most effective management strategies, costs and benefits of different options, and likely impact given available resources. It provides a method for exploring the efficiency of resource allocation for threatened species management, and hence, a rationale for prioritisation of management actions. The decision tool adds to other existing management options.

Park manager Jim Clayton shares with NERP ED scientists the challenges of managing mala, a threatened wallaby, in Uluru-Kata Tjuta National Park.

The NERP ED has also facilitated productive workshops to incorporate structured decision making into natural resource management. Workshop topics have included:

- **Guiding the development of effective monitoring programs** as a feedback system for adaptive management, including informing the purpose and planning;
- **Exploring next steps for captive breeding and management** of mala (*Lagorchestes hirsutus*) in Uluru-Kata Tjuta National Park, once the enclosure reaches its maximum carrying capacity; and
- **Identifying priority actions** for the decline of the Christmas Island flying fox (*Pteropus melanotus natalis*), a functionally-important species undergoing unexplained population decline.

Parks Australia Assistant Secretary, Parks and Biodiversity Science, Dr Judy West, considers that NERP workshops such as these have changed the thinking and management approaches of Parks staff. It has given Parks Australia NRM managers confidence in the implementation of their management strategies, knowing that they are drawing on the best available science and management practices, and using robust decision-making processes. "By the time we have done a workshop like this, we know we have more objective decisions, and can justify those decisions," says Dr West. "We can better communicate our reasoning to our stakeholders, knowing that we have drawn on the best available knowledge".

Partnerships between the NERP ED and Parks Australia have provided important insights into improving decision making in natural resource management. These partnerships have provided Parks Australia staff with new knowledge to help facilitate effective management, and in return has helped bring practical information and knowledge to the research community and provided a 'test ground' for trialling ideas.

Parks Australia staff have provided consistently positive feedback about their interactions with the NERP ED, including the engaging workshop facilitators (especially Dr Eve McDonald-Madden and Dr Terry Walshe) and enthusiastic early career researchers, who clearly explain complex scientific concepts in a practical context.

Parks Australia appreciates the close working relationship and support and engagement of the NERP ED hub and looks forward to an ongoing collaboration to continue to bring scientific insight into natural resource management.

Science & management (at Booderee)

There are many advantages to connecting management with research on the ground. David Lindenmayer and his research group from ANU have developed a strong and enduring partnership with the management team at Booderee National Park (a part of Parks Australia), a coastal reserve next to Jervis Bay on the south coast of NSW (Lindenmayer et al., 2013). The partnership has focussed on three key issues within Booderee: the impacts of fire on native biota, the response of vertebrates to feral animal control and the control of Bitou bush.

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

Reference

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

Science, nature-based tourism and protected areas

Lessons from South Africa

By Duan Biggs (University of Queensland)

Nature-based tourism is a key recreational and economic activity around many protected areas and national parks. Not only do protected areas expose citizens to nature and the value of conservation, they also offer an opportunity to contribute to the funding of conservation. South Africa is an excellent example of how the development and management of a system of protected areas can be funded largely though nature-based tourism.

South African National Parks (SANParks) is responsible for managing 19 protected areas. It was created in 1926 through an act of parliament with a core mandate of the conservation and management of cultural and natural heritage through a system of protected areas. From its inception, SANParks was created in a way in which it is able to generate revenue from tourism to fulfil its mandate. In fact, tourism revenue amounted to 84% of total income to SANParks in the 2011/2012 financial year. Could there be lessons here for Australian protected areas?

Protected areas in Australia, at both the state and federal level, are under increasing budgetary pressure, and there is a drive to increase access to them for a range of recreational purposes (including hunting and bike racing). Some of these developments may impact on the natural values of these areas, others may have no or very little impact.

The South African experience suggests that increasing recreational access to protected areas, if planned, and managed appropriately, with revenue flowing back to protected area development and management, can be beneficial for conservation (Biggs et al., 2014). Of course there are both opportunities, risks, and potential trade-offs, something SANParks has long acknowledged. To improve the scientific understanding of these trade-offs and synergies and the broader interaction between tourism, recreation and conservation, SANParks commenced with the development of a tourism research program in 2011 to inform management and policy.

Indeed, SANParks is constitutionally mandated to raise its own funding through tourism. The organisation is also to build a constituency for conservation among all races in South Africa (pre-1994, during Apartheid, access to protected areas was primarily restricted to whites). A principle for generating and growing income through tourism is that these developments should be synergistic with building a constituency for conservation among all South Africans, and be designed to have no or minimal impact on conservation.

An example in South African protected areas is the type of accommodation on offer. Current evidence suggests that middle class and wealthy non-white South Africans would visit parks in higher numbers if more city-style high quality hotels rather than the current more rustic bush-style accommodation becomes available. An obvious synergy exists here – build more appropriately designed city-style high quality hotels in protected areas on non-sensitive sites. This can enhance constituency-building whilst increasing revenue for conservation (provided the hotels are managed soundly) with minimal impact on biodiversity. Also, additional activities can be allowed or made available that cater to the demands of non-traditional visitors to protected areas. Targeted social and ecological research can help identify these synergies and how to best exploit them.

There are large segments of Australian society that similarly have little interest in visiting protected areas. The political drive to increase

> "An obvious synergy exists here – build more appropriately designed city-style high quality hotels in protected areas on non-sensitive sites."

Increasing recreational access to protected areas can be beneficial for conservation. (Photo by Joep Stevens)

recreational access to Australian protected areas therefore presents an opportunity. Perhaps there are activities such as horse-riding, mountain-bike races, or even fishing that can increase the constituency visiting and concerned about protected areas in Australia. However, that requires that these activities are carefully planned and managed to ensure that the conservation impact is kept to a minimum and that highly sensitive areas are avoided.

Allowing increased recreational access should go hand in hand with income-generating activities so that new recreational activities provide funds for conservation. Appropriate awareness-raising systems need to be in place so that 'new' visitors are made aware of the conservation importance of the protected areas in which they are now undertaking their favourite activity. Research can play an important role in targeting this messaging; as it does in SANParks to communicate a conservation message to newly wealthy non-white visitor staying in a city-style 5-star hotel in a protected area.

Many traditional visitors to protected areas in South Africa, like in Australia, are very negative about such new developments, even if it can be shown that the conservation impact is minimal. However, the future of conservation in South Africa is critically dependent on building a constituency for conservation and maintaining and growing income levels to SANParks.

Similarly, protected areas in Australia may be better off in the long term if carefully planned non-traditional conservation activities are permitted in a way that enlarges the constituency for conservation in Australia, and raises more revenue for protected areas management. As in South Africa, research is important to inform the development of these opportunities by identifying trade-offs, where win-wins are possible, and where certain types of recreational access should be limited.

More info: Duan Biggs d.biggs@uq.edu.au

Note: Before joining EDG as a Post-doctoral Research Fellow at the University of Queensland, Duan Biggs worked for Scientific Services in South African National Parks where he led the development of a tourism research program

Reference

Biggs D, L Swemmer, G Phillips, J Stevens, S Freitag & R Grant (2014). The development of a tourism research framework by South African National Parks to inform management. *Koedoe* 56. http://dx.doi.org/10.4102/ koedoe.v56i2.116

Operationalising resilience thinking and requisite simplicities

EDG at the 3rd international Resilience Conference

By Duan Biggs (UQ), Morena Mills (UQ), Angela Guerrero (UQ), Rachel Standish (UWA), Natalie Ban (Univ. of Victoria), Dirk Roux (SANParks) & Nadine Marshall (CSIRO)

There is a growing emphasis on integrating resilience thinking into conservation planning and decision-making. Framed from a resilience perspective, conservation interventions aim to manage ecosystems to limit the risk of crossing dangerous thresholds into degraded and less desirable ecosystem states. Conservation interventions from a resilience perspective therefore aim to retain ecosystem functions that are important for sustaining biodiversity (eg, number of species and habitats protected). Despite conceptual advances in the literature, challenges remain in the application of resilience to both conservation science and practice.

These challenges motivated us to propose a session at the 3rd International Resilience Conference in Montpellier, France (in May 2014) where we discussed ways in which research can advance the practice of maintaining and creating resilient ecosystems and societies. Our session was run off-site at the Camargue – one of Europe's most important wetlands (in terms of its history, culture and ecology). During our session we heard presentations from numerous CEED members including Duan Biggs, Angela Guerrero and Morena Mills from the UQ node, and Rachel Standish from the UWA node. Elizabeth Kington from the Wheatbelt NRM group in Western Australia (who works closely with Richard Hobbs and Rachel Standish) presented her views from a practitioner's perspective.

A central theme through our deliberations is that there are no panaceas or silver bullets for achieving resilience across ecosystems. The task of achieving conservation outcomes is usually highly context specific. This in itself is not a new insight. However, Dirk Roux from South African National Parks (SANParks) shared how their adoption of adaptive management has helped them embrace complexity within important parts of this conservation agency (Roux & Foxcroft 2011). An overview of their learning process can be found in a special issue of the open-access journal *Koedoe*. A lesson emerging from the SANParks experience is that 'requisite simplicities' can help to negotiate complex problems.

A requisite-simplicity approach discards some of the complicating details about a problem to bring a fresh perspective and achieve a more holistic understanding of the key components at play (Stirzaker et al., 2010). In essence, getting to a requisite simplicity means standing back and ignoring details that may shroud the key elements. It enables the generation of a fresh social-ecological perspective that allows critical triggers to be identified. In this way, requisite simplicities require an understanding of ecological thresholds of resilience but are nested within the broader context of social-ecological systems. Importantly, formulating a requisite simplicity does not mean there is a simple answer to a complex problem. Rather, it propose that discarding some detail might reveal new clarity and understanding, enable decisions and actions, and provide opportunities for structured learning. The talks in our session touched upon requisite simplicities and the need to develop them to more successfully operationalize resilience for conservation in a number of ways.

Consider this example. The relationship between the ecological resilience of the Great Barrier Reef (GBR) and the social resilience and well-being of people on the adjacent coastline is a hot topic in Australia. Nadine Marshall from CSIRO presented her work on this topic. We could go into considerable detail to understand how socially resilient communities such as those in Cairns are vulnerable to a decline in reef condition that may lead to a drop in tourism. This could get us lost in very complicated ecological and socio-economic surveys and modelling exercises. We may conclude that communities in the GBR should develop alternative income streams to those based on the GBR. This would enable communities to adapt to the declining reef condition, thereby increasing their resilience . However this conclusion may not help us to enhance the conservation and resilience of the reef itself.

Nadine's suggested requisite simplicity is that we should acknowledge that people are part of the GBR and that the GBR is an important part of the cultural identity, pride, and lifestyle of many Queenslanders. By investing in the capacity of people to better connect with and manage the GBR, the GBR will continue to provide essential goods and services. That is, instead of promoting alternative activities to those based on the reef (and increase social resilience), we could support and promote the focus on the reef and society's connection to it, and in doing so, increase the resilience of the social-ecological system of the Great Barrier Reef. Applying this fresh perspective means that we would, for example, try and work out how to strengthen the resilience of reef tourism operators to potential downturns in tourism, so that these businesses can stay active on the reef and become involved in its conservation (see *Decision Point #66*).

Morena Mills presented her PhD research on the application of Eleanor Ostrom's framework on social-ecological systems to identify social characteristics that influence feasibility of conservation management actions in the Solomon islands (see *Decision Point #75*). The framework aims to bring a common language to research on social-ecological systems, and through its tiered structure, helps to simplify and standardize such research. Based on previous research and management efforts, Morena created a social-ecological systems framework to describe the Solomon Islands. One of Morena's conclusions was that it may not be an effective use of resources to conduct detailed social surveys in all the places where conservation plans and actions need to be implemented. Instead, understanding the main drivers of participation in conservation management is crucial. Requisite simplicities for identifying the likelihood and social feasibility of participation is required.

In searching for these requisite simplicities, we need to accept that we will make mistakes and that defining, refining and adapting these simplicities to achieving resilience as part of conservation outcomes will be a process of adaptive learning. What our session concluded was that we need to focus more explicitly on identifying these requisite simplicities, and actively use and adapt them in our research and management actions. In doing so, we re-emphasize the relevance of the now-customary mantra 'resilience of what, to what, and for whom'. In this way, more progress on operationalizing resilience for conservation may be possible.

More info: Duan Biggs d.biggs@uq.edu.au

References

Roux DJ & LC Foxcroft (2011). The development and application of strategic adaptive management within South African National Parks. *Koedoe* 53(2), Art. #1049, 5 pages. Available at http://www.koedoe.co.za/index.php/koedoe/article/view/1049/1216

Stirzaker R, H Biggs, D Roux & P Cilliers (2010). Requisite Simplicities to Help Negotiate Complex Problems. *Ambio* 39: 600-607.

By investing in the capacity of people to better connect with and manage the GBR, through operations such as ecotourism, the GBR will continue to provide essential ecosystem goods and services. (Photo by Duan Biggs)

Managing invasive birds wisely

A CEED workshop

(Canberra, June 2014)

By Salit Kark (UQ) & David Lindenmayer (ANU)

The science and management of pest mammals has received substantial attention in Australia over the past decade. Much less work, however, has been done on invasive birds, which is unfortunate as alien invasive birds can have substantial and wide ranging impacts. Thanks to continuous data gathering by birders, there is information on their spatial and temporal patterns of establishment. In this workshop, we attempted to bring together experts from a range of organizations across Australia to advance our understanding of invasive birds management and to develop collaborations.

Workshop participants brought with them expertise on avian conservation, ecology, invasion biology, environmental decision making and behavior, and perspectives from a range of academic, governmental and non-governmental organisations. These included the University of Queensland, ANU, University of Newcastle, University of Canberra, University of Adelaide, University of Tasmania, Rutgers University (USA), Biosecurity SA, NSW Department of Primary Industries/Orange Agricultural Institute NSW, Invasive Animals CRC, Australian Museum (Sydney), BirdLife Tasmania and the Canberra Indian Myna Action Group.

Participants of the invasive birds workshop earlier this year.

In the workshop, which took place at the Mt Stromlo Observatory, participants updated each other on their current and past work in the area; and discussed a range of new research directions including: the importance of among-species interactions in the avian invasion process, impacts and the efficiency of control measures, and the role of social media in invasion research. One of the important issues that came up was the lack of robust information on the motivations for and outcomes of control efforts.

A small follow up CEED/NERP workshop focusing on bird invasions on islands took place during July 2014 in Queensland.

More info: Salit Kark s.kark@uq.edu.au

Research by the Kark Group in Queensland and NSW (funded by the ARC) into native cavity nesting bird species and their interactions with invasive pest species.

Dbytes

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

1. Understanding the capacity of NRMs

The report Understanding the capacity of NRMs to manage invasive animal impacts: Results from the 2013 National NRM Survey was part of the Invasive Animals CRC National NRM Facilitator Project, the report examines a survey of staff responsible for pest animal management in each of the 54 NRM regions.

http://www.feral.org.au/2013-national-nrm-survey/

2. The battle over Australia's brumbies

It's been a hard winter for Australia's wild horses. But things may be about to get much worse for these totemic animals. Their swelling numbers are damaging the continent's precious alpine ranges, and tensions are mounting over what needs to happen next.

http://www.theguardian.com/world/2014/aug/20/-sp-a-time-to-cull-the-battle-over-australias-brumbies

Also see http://theconversation.com/the-grim-story-of-the-snowy-mountains-cannibal-horses-31691

3. The Red List of Ecosystems

Earlier this year, the IUCN adopted the categories and criteria for the identification of threatened ecosystems and the creation of Red Lists of Ecosystems.

For the full history of the IUCN Red List of Ecosystems see http://www.iucnredlistofecosystems.org/press/news-releases/adopted-cc-iucn-rle/ or read our story in *Decision Point #72*

4. Maps for threatened species

The Department of the Environment has released more than 1700 new maps and data that local communities can use to find threatened species in their area.

http://www.environment.gov.au/science/erin/databases-maps/snes

5. Strategic assessment of the GBR

GBRMPA's 25-year management plan outlines how it will strengthen reef management with new initiatives such as clear targets for action and reef-wide integrated monitoring. It follows a comprehensive strategic assessment of the Great Barrier Reef World Heritage Area.

http://www.gbrmpa.gov.au/managing-the-reef/strategic-assessment

6. An Environmental Expenditure Account

The ABS issued 'Discussion paper: Towards an Environmental Expenditure Account, Australia, August 2014'. Establishing accounts for environmental expenditure would identify and measure society's response to environmental concerns through the supply and demand for environmental protection services.

http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4603.0.55.001Main+Features1August%202014?OpenDocument

What's the point?

How many $ to save biodiversity?

How much money is needed to save biodiversity? Donal McCarthy and colleagues did a 'back-of-the-envelope' calculation for Science *magazine of what it would cost to reduce the extinction risks of the world's threatened animals (McCarthy et al., 2012). They used expert opinion combined with known costs on what it would take to save individual species and important areas of habitat. Their calculations involved big assumptions, large extrapolations and some guess work, but their estimates still provides one of the few benchmarks on what level of resources would be required if the world was serious about halting biodiversity decline. The figure they come up with is around US$75 billion a year.*

So, if the world's nations were to contribute $75 billion a year to the conservation of biodiversity, it's believed we might be able to make a real difference to the current situation. McCarthy et al point out that this would involve an order of magnitude increase in what is currently invested but that there is a strong case to do it.

"The total costs are small relative to the value of the potential goods and services that biodiversity provides," they point out. They quote sources that put the consequences of biodiversity loss as being equivalent to 1 to 4% of the estimated net value of ecosystem services that are lost per year, estimated at $2 to $6.6 trillion. $75 billion to prevent possible losses of $2-7 trillion (per year) sounds like a good investment but deciding who pays (how and when) and who benefits is a complex issue that has defied the world community since the beginning of history.

Of course, $75 billion is not an insignificant amount of money and yet, by global standards, it's but a tiny proportion of what the world's people spend every year on food alone. McCarthy et al even point out that the amount required to secure the world's biodiversity is less than 20% of annual global consumer spending on soft drinks!

Oscar Venter and colleagues have done a similar calculation on what it would take to save the world's threatened species (see our story on page 4). Their method involved comparing options for extending the global network of protected areas. If protected areas were declared in places where they would provide protection to all threatened species it would cost over US$42 billion – a lot of money but still significantly less than McCarthy et al's estimate of $75 billion.

However, Venter and colleagues went one step further by identifying what different expenditures might secure in terms of saving threatened species. They found that US$7.4 billion, one tenth of McCarthy et al's estimate, would be enough to save some 2,000 threatened species (around half of all threatened vertebrates).

Reference

McCarthy et al., (2012). Financial Costs of Meeting Global Biodiversity Conservation Targets: Current Spending and Unmet Needs. *Science* 338 (6109): 946-949
http://www.sciencemag.org/content/338/6109/946.short

ENVIRONMENTAL DECISIONS GROUP

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

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

Decision Point is the monthly magazine of the EDG.
The funding of the research presented in this issue of *Decision Point*, like most research, comes from multiple sources and is identified in the original papers on which the stories are based (references are provided in each story). In terms of CEED and NERP ED, the research on metrics (p4,5) was supported by NERP; the work on bird lists and the Wet Tropics (p6,7) was supported by NERP; the work on Christmas Island (p8,9) is being supported by NERP and CEED; the research on focal speces (p10) was supported by NERP and CEED; the work on nature based tourism on p13 was supported by CEED.

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

National Environmental Research Program

ARC ceed Centre of Excellence for Environmental Decisions

Australian Government
Department of the Environment
Australian Research Council

The University Of Queensland
AUSTRALIA

Australian National University

The University of Melbourne

RMIT University

The University of Western Australia