Prioritising resources for endangered species (like the helmeted honeyeater)

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Biodiversity, 2020 and beyond

By Sarah Bekessy (RMIT, Melbourne Node, AEDA)

It was inspirational to be a part of and the 2020 Summit, and the feeling over the weekend was overwhelmingly positive. I was impressed by the desire amongst ‘summiteers’ to arrive at good outcomes and the ability of participants to drop personal agendas in order to get there. I think we can probably learn something from the approach used of setting ridiculously short timeframes for the completion of tasks – I’ve never seen better cooperation between traditional adversaries.

My only disappointment was that both Hugh and I failed miserably to get biodiversity on the agenda. It started me thinking that it’s becoming challenging to get biodiversity issues considered in public policy. Environmental issues were mentioned in almost all of the summit themes, but it was inevitably with respect to climate change and drought. While I don’t mean to downplay the importance of dealing with these issues, it’s a vexing thought that they might have taken up the finite environmental space in peoples’ consciousness to the exclusion of other environmental concerns.

Informal discussions with public servants and NGOs tended to substantiate this concern. For example, the new biodiversity white paper in Victoria is struggling to get high level government support, partly because of a focus on the development of higher profile policy on climate change or water initiatives. Some NGOs attribute the lack of interest to poor understanding of the term ‘biodiversity’. Consider a recent survey showing that many people think biodiversity is either a washing powder or a sexual preference!

While issues of climate change and drought are inextricably linked to the future of Australia’s biodiversity, dealing with climate change does not automatically mean that we’re also doing the right thing by biodiversity. For example, biodiversity benefits are unlikely to flow from investment in the carbon offset market without some very careful thinking about the way that these markets are established (Bekessy and Wintle, in press).

Furthermore, initiatives to deal directly with the threat of climate change to biodiversity may not be the most efficient and effective use of conservation budgets. One example of an untested but increasingly popular notion to shield biodiversity from the effects of climate change is the establishment of continental-scale biolinks to allow migration of animals and plants.

Our work at RMIT on developing tools to conserve biodiversity on the urban fringe highlight the more immediate and certain impacts on biodiversity that are receiving much less attention (Bekessy and Gordon, 2007). For example, one of our Honours students, Joab Wilson, found that destruction of wetlands for urban development was a more serious and immediate threat to frog populations than the predicted drying up of wetlands due to climate change.

Despite the introduction of planning legislation and frameworks to preserve biodiversity, most Australian cities are facing a looming extinction crisis in which short-term economic gains are consistently winning out over biodiversity concerns on a localised case-by-case basis.

With over 40% of nationally listed threatened ecological communities and more than 50% of threatened species occurring on the urban fringe, there are important values at stake. The following statistics highlight recent trends in biodiversity loss in some of the major cities:

- In Perth during the period 1994 to 2003 an estimated 23% (121,900 ha) of the remnant vegetation on the Swan Coastal Plain was cleared (WA Gov 2003).
- In Sutherland Shire, Sydney, a recent risk assessment showed that bushland and mammal species have declined steadily over the past 40 years (losing 3000 ha and 12 mammal species) and stated that the main culprit is urban expansion, particularly new release areas (Science Unit, Sutherland Shire).
- In Melbourne, over 50% of the extremely limited area of endangered native grassland remaining in 1985 has since been lost to development and weed invasion (Williams et al 2005).

Unlike climate change, these impacts are deterministic and mostly under our control. While specialised tools are needed for conservation planning in these highly complex and politically charged environments (Gordon et al., in review), the task is not unsurmountable. The trick is to get decent forward planning based on a scientific understanding of landscape patterns, species requirements and development pressures and to coordinate better between local government, state and federal approaches.

Without a doubt, climate change has altered the way that decisions about biodiversity are made, but what is the role of AEDA in all of this? I think there are three obvious areas in which...
People are waking up to the issues of climate change and water shortages, but it seems we may all have gone to sleep on a bigger challenge that grows more urgent with every day.

AEDA could make a valuable contribution:

1. Are continental-scale biolinks the most efficient way to maintain biodiversity in the face of climate change? How do we rigorously assess their effectiveness?
2. How can emerging carbon markets be harnessed to enhance biodiversity?
3. Can we achieve better outcomes for biodiversity by focussing on other threats, such as urban development?

But our role as advocates of efficient conservation decision making may well need to start with getting biodiversity back on the policy agenda. Declining biodiversity is the real challenge of our generation.

More than 1 molecule & 1 atom

The 2020 summit was an exciting event to be at. It heralded in a new attempt at engaging the broader community in government decision-making. I think that is technically what a democracy is all about (not just casting a vote every three years). Congratulations Mr Rudd and the new Labor government.

I attended the Population, Sustainability, Cities and Water section (the environment mob); one of ten topics addressed at the summit. Unfortunately, I found that my personal obsession with biodiversity wasn’t shared by many others in our group. The bulk of the discussion was about a simple molecule – water, and a common atom – carbon. Of course they are both important but it would appear that managing water and mitigating, and adapting to, climate change has pushed all other concerns to the side. This is reflected in the summary documents from the summit (see http://www.australia2020.gov.au/). Are they all we have to worry about?

It was almost impossible to get biodiversity into the documents, and harder still to convince anyone to commit to a quantifiable action. I suggested that we set a specific target of slowing the rate of species loss by 2020. Penny Figgis suggested increasing the protected area system to 20% by 2020. Maybe our suggestions were too specific, things that the government could actually be held accountable for. However, I suspect such quantifiable objectives were not popular because they were not about carbon and water.

This obsession with climate change and water is quite natural. Water makes us a lot of money and we need water to survive. Water quality affects health. Climate change poses a significant and uncertain threat to the countries economy, individual well-being and interacts with many environmental assets.

The benefits of biodiversity are far less direct, more difficult to quantify and seem of less relevance to people – unless you’re one of the few like me who spend much of their spare time enjoying it.

But let’s think again about what is really important in the world. Air quality was one of the big environmental issues of the second half of the last century. Through good policy Australian cities have succeeded in rapidly solving this problem. Indeed with appropriate action air quality can be sorted out in a few years.

Similarly it will take us only decades to sort out the quality and quantity of water. It’s easy to measure, and the public are concerned about its management.

I assert that the climate change issue will be solved over the next few hundred years. We know its cause, we can quantify the amount of CO₂ equivalents produced by various activities; the solution just requires global cooperation – easy (relative to the challenge of biodiversity loss, anyway).

So, what about biodiversity loss? Let’s indulge in a little back of the envelope calculation. If we continue down the trajectory we’re on (ie, ‘business-as-usual’) and wipe out 20-50% of the species on the planet, it will take 1-10 million years (not a thousand years) for this to recover. Assuming a long-term global human population of 5 billion people and a generation time of 25 years – this means that at least 200,000 billion people will suffer the consequences of biodiversity loss – that’s over 10,000 times as many people as have ever lived! I think all the people who have not yet been born – the disenfranchised majority – will be pretty cranky with this.

I’m quite sure the big thing that future generations will remember our generations for will be the precipitation of a mass extinction that bequeaths them an almost permanent and diminished quality of life.

Of course water and climate change are also integral to the quality of life, and they’re issues that are interwoven with issues of biodiversity decline. However, I fail to understand how, in a rational forward-thinking world, we can make water and climate change priorities while letting biodiversity slip from the agenda.

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References


How should we best manage an endangered population?
It’s all about birth, death and money

By Peter Baxter (UQld, Brisbane Node, AEDA)

It’s one of our biggest conservation challenges: how should we focus our efforts in attempting to save an endangered population of plants or animals. Changes in population size occur through either births or deaths (migration – the movement in or out of the population – also affects population size, but let’s stick with births and deaths for now). So in many cases the decision of how to boost a population boils down to whether we should try to increase the survival rate of individuals, or increase their reproductive output (“fecundity”), things demographers refer to as the population’s vital rates.

And the same question applies for controlling pest populations, but in reverse. How should we try to reduce a pest population: by reducing the birth rate or increasing the death rate? Whether we want to reduce the long-term population growth rate or increase it, the most efficient management option depends on the vital rate that has the greatest per-dollar effect on the population in which you’re interested.

(St)age-structured models & turtles

So, which vital rate should we focus on, survival or fecundity? One common way of tackling this question relies on a demographic analysis that examines different life-stages (eg, ages, or different sizes) of the population. By using these life-stages to examine demographic characteristics – the survival within different life-stages, the organism’s progression from one stage to another, and its reproductive output at each stage – population ecologists can find out which of these components are most important for the long-term growth rate of the population.

For example, a common finding for long-lived species is that the survival of adults is the main driver behind population growth, suggesting that – all else being equal – increasing adult survival may be the best way to boost the population growth rate. So far so good, all else being equal.

The first application of this method examined loggerhead turtle demographics in the southeastern USA (Crouse et al, 1989). They found that the most critical parts of the turtle life-cycle were juvenile and sub-adult survival. At the time, turtle conservation efforts were focused on protecting eggs and helping hatchlings to make it out to sea, but, consistent with the model’s predictions, the installation of Turtle Excluding Devices (TEDs) on trawlers led to a decrease in adult mortality with further modelling suggesting possible recovery of turtle populations in the region. Although the loggerhead turtle remains classified as endangered, this early apparent success led to the structured-population model approach being widely adapted in conservation analyses, often becoming a standard output in conservation software packages.

One critical aspect of the turtle story, however, is that the installation of TEDs on trawlers was relatively straightforward, legally binding and therefore widely adapted. However, not all cases are so clear cut when deciding whether you should place a greater emphasis on managing survival or fecundity.

One important aspect of the decision making process that is often ignored is the cost of the proposed management. It’s critical when deciding how you’ll spread your investment to take into account the difficulty – or expense – in improving either survival or fecundity. Because in most situations different management actions come with very different price tags, and in the real world these can’t be ignored.

Incorporating management costs

Indeed, merely looking at the vital rate that has the biggest influence on population growth rate and then concluding that that’s the most appropriate one to manage can actually be quite illogical when management costs are ignored.

One approach to incorporating management costs into your decision process is to first analyse how a particular investment on a particular vital rate will change that rate. Then we can combine this with the effect that changing that vital rate has on the overall population growth rate. This simply gives the improvement in population growth rate per amount spent on improving a particular vital rate. This is the ‘efficiency’ of spending money on that vital rate – a straightforward cost-benefit or ‘bang-for-buck’ approach.

So we can find, for example, how much $1 invested in increasing survival will cause the population to grow, and compare this with $1 invested in increasing fecundity to find the best way to spend our money (of course, the dollar amounts could be some other measure of management effort).

It’s not just simple, it’s also a sensible approach to deciding how to invest your resources. To do otherwise, and ignore costs, may result in a huge waste of limited conservation funding. Having said that, for almost two decades the two parts of the process have been kept separate – many studies just found the most influential vital rate and then advocated that managers focus on that, often without discussing the practicalities, costs or difficulties of doing so. It’s a bit like getting advice on what’s the fastest way of getting to the shops and being told to buy a helicopter when a bike would have been a wiser way to go.

Managing for helmeted honeyeaters

So, how might this process work in a real life conservation situation? Let’s consider management options for the helmeted honeyeater (Lichenostomus melanops cassidix), an endangered bird in Victoria that also happens to be the state’s bird emblem. The traditional demographic approach suggested that managing would be about four times better than managing reproduction (see figure 1). However, it’s incredibly difficult and costly to increase survival

“It’s critical when deciding how you’ll spread your investment to take into account the difficulty - or expense - in improving either survival or fecundity”
Notes on the model

Of course, this structured-model approach contains many simplifications and assumptions. However, our work on a more sophisticated model – one that simulates the fate under various conditions of every individual bird in a helmeted honeyeater population – also indicates (albeit less strongly) that protecting nests is the way to go.

Over the long term conditions will change and it’s likely that the efficiency of managing our selected vital rate will eventually drop (for example survival rates can never be increased beyond 100% no matter how much money we pour into survival management). At some stage then it’s likely that the other vital rate will become just as efficient to manage. At that stage we should manage both survival and reproduction together equally. Which is not to say that management money should be split 50:50 between survival and fecundity, but rather in the ratio of their unit costs (eg, cost of increasing each by 0.01), so the bang-for-buck is the same for each, and the overall bang-for-buck is maximised.

And what about uncertainty? With all those approximations and assumptions in the model (including the assumption that the model is appropriate at all), we can’t be exactly sure of the costs, the effects of costs on the vital rates, and the knock-on effects on the population growth rate. However, work in progress suggests that to account for uncertainty, a degree of bet-hedging between different management options may be appropriate, while still devoting the majority of funding to managing the vital rate with the highest efficiency value.

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References


Managing alpine willows

And the model of a good decision

In 2003, bushfires ravaged large sections of the Bogong High Plains in Victoria’s high country. Twelve months later alarm bells began ringing when it was noticed that grey willow seedlings were shooting up from the burnt alpine wetlands. The grey willow is considered one of the most invasive of the willows producing large amounts of wind-dispersed seed. These seedlings probably originated from adult populations located on the rivers and the associated headwaters in the valleys to the north west of the Bogong High Plains.

The seedlings have yet to reach reproductive maturity but Parks Victoria has a new management headache to add on to all its other responsibilities. How much resource should it invest in preventing a major weed outbreak in the precious alpine wetlands? How should it divide that resource between destroying the seedlings and tackling the seed source to prevent future infestations?

Dr Joslin Moore is working with Parks Victoria to explore these issues, and she’s hoping her background in ecological modelling and optimal decision making will make a valuable contribution in tackling the willow threat before it gets out of hand.

Joslin is an AEDA Research Fellow based at the University of Melbourne, after which research marks a welcome return for her to the world of conservation science. She originally trained in ecological modelling of invasive weeds and conservation planning but then took a break from research.

“I was finding research a bit unsatisfying in terms of making a really practical impact,” explains Joslin. “So, for several years I took a complete break from science – working for the ABC managing their consumer affairs database, and then for the Commonwealth Government administering major research infrastructure funding.

“Then I found out about AEDA and the opportunity to apply my skills in optimal management for conservation in the real world was very appealing. The decision theory used in optimal monitoring and optimal management combines similar mathematical techniques used for priority setting with ecological models. This seemed like a great opportunity to use a whole set of skills I had developed over the years in a practical context.”

Joslin is developing case studies of optimal monitoring, adaptive management and decision theory for conservation management in alpine systems, and she’s starting out by looking at weed management, specifically by working with Parks Victoria on the willow problem in the high plains.

“It’s quite an interesting challenge both ecologically and from a management point of view,” says Joslin. “And, because this is an emerging challenge rather than an age-old intractable problem like, for example, broom infestations, I think there’s a strong chance that we can demonstrate how valuable a good decision theory framework can be in making a positive impact early in the invasion process.

“And this really is about coming up with practical solutions. To begin with, the project was suggested by on-the-ground managers from within Parks Victoria, so I’m working with the people that are implementing the strategy, and they’re very supportive of my input. We’ve also set up a project advisory group to ensure we get input from a broad group of stakeholders including the National Willows Coordinator, the Victorian Department of Sustainability and Environment, and officers from the North East Catchment Management Authority (CMA).”

Joslin says the experience has been both interesting and challenging. There’s an initial decision about what the total budget will be (made centrally) and then how you allocate resources to each of the individual tasks made by the park managers. It quickly became apparent that park managers had so many responsibilities that they had little time to put into individual decisions.

“This can result in decisions that can appear obscure, often ad hoc and last moment.” Joslin explains. “That’s partly because there’s a lot of uncertainty around these types of decisions. And what often happens in these circumstances, especially when time is short, is that the decisions are made quickly and intuitively rather than taking a bit of time to work through the variables to come up with a robust solution. I’m hoping I can help here.

“I’m also trying to assist in the development of standard data collection protocols to record the control activities and its impact – so we have an opportunity to learn from our past efforts.

“The kinds of issues the modelling I’m using is trying to help with include where to concentrate your eradication effort: should you concentrate on the young seedlings on the high plain or on possible seed-source locations that are lower down? What makes the process difficult is the uncertainty; the distribution of possible source populations and seedlings is not well known. The dispersal distance between source populations and the high plain is also not well known.

“In the first few years, a lot of effort has been applied to the source populations, around 80% of the effort. However, even though the analysis is still in its early days, the bit of modelling we’ve done so far suggests its better to prioritise seedling removal, and this has shifted where the resources are going.
"The logic is that it’s much cheaper to control seedlings than it is to control source populations because seedlings are easier to remove and the seedling population is much smaller. If your objective is to keep seedlings from the high plains then, for a given amount of effort or resources, you can probably get more seedlings off the high plains by just going out and removing them than you could by controlling a small amount of the source that really wouldn’t reduce next year’s seed rain. So it’s cheaper to remove seedlings than it is to deal with the whole problem provided you can actually control all the seedlings.

"The main outcome of the initial model is to highlight that your optimal decision really depends on this trade-off between seedling-control effectiveness and source-control effectiveness. And because we have no information on either of these two things it’s very difficult to even know where you are on that continuum let alone estimate the level of resources you would need or what a good strategy would be.

"Parks Victoria are taking this on board and are trying to get some of that data so they can get a handle on how effective their programs are, and how expensive these different options are because this initial allocation problem is all about the trade off between the cost of seedling control versus source control. Initial estimates suggest that seedling control is only a hundredth or a thousandth of the cost of source control, so that’s probably the best way to go if you haven’t the resources to have a really good go at the source."

Joslin says she really enjoys the practical application of this work.

"This is an excellent balance for me of good rigorous science, an interesting ecological problem and a useful application," she explains. "The work I’m doing now is really affecting the things that are happening on the ground this year and years to come. I’m hoping that we’ll see a big improvement in willow control on the High Plains over the next few years and that this work is really helping the rangers to develop and implement an effective control program."

The value of Joslin’s work also lies in presenting a case study of how to successfully deal with a real challenge via decision theory, and in setting up a general framework to deal with these weed invasion problems. While the alpine willows problem is a small focussed project, it addresses the larger issue of how do you develop a decision framework that is appropriate and valuable to land managers. It can’t be too abstract or complex.

Results so far suggest that the value of good and transparent decision are making a difference on the ground and influencing land managers to consider similar processes in the future.

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Profile of a pest plant

The grey sallow or pussy willow (Salix cinerea) is considered one of the most invasive willows in Australia. It’s a large spreading shrub or small tree with twigs or branches that are hard to break. It reproduces mainly by seed. The grey sallow is highly invasive in swamps, drainage lines and other moist sites including lowland and mountain streams. Large and rapidly expanding populations occur in Victoria, and this species will probably become a major wetland and riverside weed (as it is in New Zealand). It also forms hybrids with other shrub willows. Recent work suggests the seeds may be able to travel tens of kilometres.

Widespread establishment of grey sallow in alpine wetlands is a new phenomenon. High levels of seedling establishment have not been reported in unburnt wetlands although some establishment has been reported in degraded wetlands. This suggests that high levels of germination may be specifically linked to burning of the alpine wetlands in 2003 and 2006.

Seedling establishment in the alpine wetlands also appears to be limited by the distribution of seed sources. The seed source for the Bogong High Plains infestation is believed to have originated from the rivers and the associated headwaters in the valleys to the north west of the Bogong High Plains. The seedlings noticed in 2004 have not been reported as reaching reproductive maturity. Grey sallow can reach reproductive maturity in as little as 2-3 years in lowland Victoria but its not clear if higher elevation slows the rate of maturation (though it appears likely).

Where should we put new protected areas?

Consider cost and threat before biodiversity

At a global scale, how do you best protect biodiversity? Our traditional approach to prioritising conservation resources has been to identify the biodiversity value of an area, and is often stymied by a lack of information. Even if you can count the number of mammal species, what about the reptiles? How about the beetles? A new analysis, however, has found that if you want to effectively protect global biodiversity then it’s most important to first factor in the cost of that conservation effort and the possibility of losing species. Less important is the need to determine the biodiversity present in individual areas. The research was undertaken by Dr Michael Bode as part of his PhD with Hugh Possingham at the University of Queensland (Michael is now an AEDA Research Fellow at Melbourne Uni)

Michael thinks the research, developed with colleagues Dr Kerrie Wilson and Ms Marissa McBride and recently released in the Proceedings of the National Academy of Science, could upset some biologists.

"Conservation biology, as you might guess from the name, is a field still predominantly interested in biological questions, and one favourite is identifying places where lots of endemic species (species found nowhere else) are located," says Michael. "If these places have lost a lot of their original habitat, then they get called 'biodiversity hotspots'."

"However, our research suggests we should be more worried about the costs of conservation and other socio-economic factors, and less obsessed by determining exactly what species are present in which areas," he says. "Taking the time to amass the necessary biodiversity information often delays the process of making conservation decisions because we generally don't know enough at the start.

"This new research means that, in many cases, we no longer need to collect huge amounts of detailed, expensive biological information on where all these groups are found before we know where to act – we can act now."

Kerrie Wilson (Director of Conservation for TNC in Australia) said the planet was facing a global extinction crisis and many international conservation agencies and governments had established alternative, and often divergent, approaches to identify important areas for protection.

"Quite simply, the science behind prioritising areas for conservation has not been conclusive," says Kerrie. "Traditionally you would identify places where there are lots of species found nowhere else. If these places have lost a lot of their original habitat, then they are considered key priorities for conservation spending. Important issues such as the relative cost of conservation are often not explicitly incorporated."

Michael points out that the official list of biodiversity hotspots was put forward in the late 1980s, with a focus on which areas of the world contribute the most towards slowing the current rate of extinction of global biodiversity.

"Yet they didn't consider cost," says Michael. "Their answer to this question included Coastal California and the French Riviera."

"However, species richness isn't the only thing we need to consider when planning conservation actions. True, the objective of conservation biology is to protect as many species from extinction as possible, but that depends on more than just where the most species are found.

"Conservation, despite it’s focus on biology, needs to work within a socio-economic context. For example, most conservation involves the purchasing of land for protection. So, where is land expensive, and where is it cheap? The Californian Floristic Hotspot has more endemic plant species than the Guinean Forests of West Africa – but how much does coastal land cost in California? If you only had a couple of million dollars to purchase land, which region would you get the most protected plant species per dollar?"

"Other socio-economic factors include the rate that habitat is being lost (a very different measure from the amount that has already been lost), and the amount of habitat which is currently protected.

Location of the biodiversity hotspots targeted for funding (from Bode et al, 2008).
The trouble with hotspots

The trouble with biodiversity hotspots is that they don’t overlap.

A good example of a biodiversity hotspot is New Caledonia. It’s a very small place – only around 20,000 square kilometres – and it’s absolutely writhing with plant species found nowhere else; in the order of 2,500 species. The island is a continental offshoot of Gondwana, but it spent part of the Eocene on the sea-floor, gathering a rich covering of minerals including gold, copper, nickel and chrome, and it carries a wide range of different soil types. And the island’s plant species have diversified incredibly to cope with the varied soil. Unfortunately the minerals also attract mining, and as a result, very little of the land’s original habitat is left.

But if you were interested in mammal species rather than plant species, New Caledonia wouldn’t be very remarkable - its isolation from the continents has kept it almost mammal free (no terrestrial mammals at all, just a few bats and marine mammals). This sort of ‘non-congruence’ is a rather serious problem, because it means that if we are keen on spending money to protect these hotspots, we would need a different set for each taxonomic group: one for the birds, one for the mammals, one for the reptiles, and so forth. A lot of recent, high profile papers have looked at the global distribution of various taxa, and note with sadness that their hotspots don’t overlap.

The research that has delivered these findings of ‘non-congruence’ normally conclude with statements along the lines that we need more research on where the different taxonomic groups are found before good decisions are made on how to protect this biodiversity. Bode et al (2008) however is suggesting we don’t have to wait for more taxonomic information before making a good decision. If we incorporate cost and threat into our decision making we can protect biodiversity just as effectively but possibly a lot sooner.

Hugh Possingham points out that previous research with Kerrie and Michael had shown the importance of including costs in setting priorities.

“However, this paper makes our case more explicit by showing that areas like Coastal California and the French Riviera are too expensive,” says Hugh. “Places like Madagascar and the Horn of Africa give conservation agencies a much better return on investment from their biodiversity dollar.”

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If you’d like to read the analysis see:

Playing with fire
Taking the guesswork out of fire mosaics

By Don Driscoll (ANU, Canberra Node, AEDA)

Fire is one of our more visible land-management tools. Most of the time its sole objective is fuel reduction for asset protection, but fire management also has important implications for biodiversity conservation. Frequent fire and the complete suppression of fire have both been implicated in species’ declines.

With fire benefitting some species, but having detrimental effects for others, the obvious solution is to maintain a mosaic in which there are areas burnt at different times in the past. But what is the appropriate range of times-since-fire? Do burns of similar age need to be next to each other to allow colonisation, and what’s the appropriate size of the management fires? Currently there are no answers to these questions, and so designing fire mosaics is guesswork, with no guarantee that it will meet conservation objectives.

So, with colleagues at Flinders Uni, Wollongong Uni, the NSW Department of Environment and Climate Change and the SA Department of Environment and Heritage, we designed a three-pronged research program to help fill in the information gaps. First, our PhD students will study reptiles, birds and plants in the field. They’ll examine how wildlife use habitat, animal behaviour, reproduction and how survival is affected by the time since the last fire.

Second, our hard-working students will take to the lab and use genetic methods to understand the dispersal ability of our focal species to discover if time-since-fire influences movement. Combined with their direct evidence of dispersal in the field and demographic and habitat data, they will be able to describe the mechanisms that influence each species’ response to fire.

The third prong is still being planned, but will involve a post-doctoral fellow doing computer simulation modelling using the detailed biological data that’s been collected. With cleverly designed simulation models based on solid field evidence about how the study system works, we will be able to model the responses of multiple species to contrasting fire mosaics. Our ambition is to be able to conduct virtual experiments that could never be done in the field because replication at the necessary scale is impossible and the duration of each experiment is prohibitively long.

PhDs to play with fire

Inappropriate fire regimes threaten many native species with extinction. To manage fire for biodiversity protection, we need to understand the ecological responses of native species to fire. Two PhD scholarships are available to address these pressing ecological problems.

1. Plant responses to fire; ecology (Wollongong University)

Using diverse plant species, the project will estimate population structure, survival, fruit production and recruitment in locations with contrasting fire histories. Seed bank longevity has a critical influence on recovery after fire and so dynamics of seed banks will be explored.

2. Plant responses to fire; population genetics (Flinders University)

This PhD will use new genetic methods to measure dispersal of plant species in relation to time since fire. A combination of chloroplast and nuclear DNA will be used to distinguish pollen from seed dispersal. This rapidly developing field provides an exciting opportunity for a student to master lab techniques and reveal patterns of dispersal by plants after fire.

For more information on these scholarships, contact Don.
Should we protect the strong or the weak?
Risk, resilience and the selection of marine protected areas

By Eddie Game (UQld, Brisbane Node, AEDA)

Unfortunately, we are being made increasingly aware that simply protecting marine habitats with marine protected areas (MPAs) does not always guarantee their survival. Perhaps the best example is the impact of mass coral bleaching events which can devastate protected and unprotected reefs alike. A severe bleaching event can result in widespread coral mortality, essentially the loss of primary habitat, a pretty catastrophic event for any ecosystem.

Although marine ecosystems face many threats, the risk of catastrophic events such as coral bleaching or cyclones are particularly challenging because the level of risk is beyond the control of conservation decision makers (even if they ride their bike to work every day) – and yet it can have a huge impact on the success or failure of our conservation actions.

Although we can’t change the level of risk to a particular reef, protecting reef from exploitation and other direct anthropogenic threats can improve the speed at which they recover from these large-scale disturbances. The ability to recover following disturbance is generally referred to as ‘resilience’ and there is now a major push to manage ecosystems with the explicit goal of maintaining resilience.

“A cross a system of reefs the level of risk is not uniform... This leaves us with a choice: protect the areas at lowest risk of disturbance in the hope that their generally healthy state is able to compensate for the poor state of unprotected areas; or alternatively, prioritise protection of high-risk areas, because they stand to gain the most from the improved recovery trajectory”

In recent years there have been numerous high profile papers (in Nature, Science etc), emphasising the importance of protected areas in promoting the resilience of coral reefs. However, the most common decision made by a coral reef managers and conservation biologists is, “which areas to protect?”, and none of these papers provide any guidance on how to make this decision.

Across a system of reefs, the level of risk is not uniform and the differences even within a region can be quite pronounced; some areas are disturbed very frequently and others rarely. This leaves us with a choice: Protect the areas at lowest risk of disturbance in the hope that their generally healthy state is able to compensate for the poor state of unprotected areas; or alternatively, prioritise protection of high-risk areas, because they stand to gain the most from the improved recovery trajectory that protection offers. In essence, should we protect the strong or the weak? We answered this question by mathematically investigating the performance of both strategies.

The correct answer to this question depends on both the objectives of the reserve system and the actual level of risk being experienced. If we only care about the health of protected reefs or simply want to ensure that there is always at least one healthy reef in our system, then the best strategy is to protect reefs at lowest risk.

On the other hand, if we wish to maximise the expected number of healthy reefs in our system, the optimal strategy is more complex. If protected reefs are likely to spend a significant amount of time in a degraded state, either because they are disturbed frequently or recover slowly, then it is still best to protect low-risk reefs.

Alternatively, if most reefs are generally healthy then, counter intuitively, it is best to protect the reefs at highest-risk. So perhaps the best answer to the question, Should we protect the strong or the weak? Is, protect the weak of the strong and the strong of the weak.

The proper treatment of risk has become a cornerstone of all forms of investment and insurance, fundamentally changing the nature of these industries and pulling successful outcomes away from sheer luck and into the realms of predictability. Conservation investment should be no different.

More info
Game ET, McDonald-Madden E, Puotinen ML and Possingham HP (in press) Should we protect the strong or the weak? Risk, resilience and the selection of marine protected areas. Conservation Biology.

A Game presentation!

This article is a summary of a presentation that Eddie gave at the Student Conference on Conservation Science at the University of Cambridge in March. Eddie’s an AEDAite working on risk management and conservation planning as part of his PhD with Hugh Possingham at the University of Queensland. Not only is this field rapidly emerging as a key issue for conservation around the globe, Eddie’s presentation of his research was judged as being excellent.

“Very simply, Eddie gave a great talk about his work on handling risk in marine reserve planning,” said Professor Andrew Balmford the conference organiser. “It was judged the best out of the 32 student talks given at the three-day meeting – no mean feat, considering these are themselves picked from over 150 applicants from around the world. This year’s talks were particularly good, too, with several of the silverback plenaries saying they thought they were of higher quality than at many more senior meetings”.

For his efforts, Eddie won a subscription to Conservation Biology and a number of books. Well done Eddie!

Decision Point #19 - 11
Marxan's new website

Bigger, easier & sleeker

By Lindsay Kircher (UQd, Brisbane Node, AEDA)

Marxan, the world’s most widely used conservation planning software, now has a new website at http://www.uq.edu.au/marxan. The revamping of the site has led to additional content, a simpler (easier-to-remember) web address, user-friendly navigation, and a sleeker look.

The primary purpose of the Marxan website is to provide the freely available software and related documentation, but the new website introduces additional features to reflect the findings of a recent survey of Marxan website visitors. Suggestions and input from the survey were incorporated into the design and content of the new website to better meet the needs of conservation planners, natural resource managers, and researchers.

One of the new content areas is the ‘Teaching & Learning’ section. It emphasises the basic skills and knowledge necessary for new and existing users to apply Marxan to a variety of natural resource problems. Another new feature, called ‘Marxan at Work’, showcases on-the-ground projects, recent research projects, support tools, and learning opportunities. The new website design aims to encourage Marxan users to interact with the rest of the Marxan community by making it easy to sign up for the Marxan email list, submit questions or suggestions, and sign up for courses. The Marxan ‘R & D’ section is an excellent place to learn about the progress of recent research and development such as Marxan with Zones, and browse through ideas for future software development projects.

Some additional features will be added to the website in the coming months, including an interactive online tutorial and the ability to search and submit publications and case studies. Visit the website today to see all the changes!

More info:
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Romola Stewart <r.stewart@uq.edu.au>

Lindsay Kircher adds some final touches to the new Marxan website. Check it out for yourself at www.uq.edu.au/marxan

The place of happiness

Breaking news from the world of ecological economics: A recent study correlating where people live and happiness found that windspeed and temperature has a significant influence on well-being. It also found that access to major transport routes and proximity to coast and to waste facilities all influence well-being. However, the manner in which they enter the happiness equation differs depending on the amenity in question.

Who would have thought? Read it yourself at:

“Paradise is exactly like where you are right now… only much, much better.”
Laurie Anderson, Language is a virus