Connecting conservation policy makers, researchers and practitioners

Reptiles in the regrowth

What’s the conservation value of regrowth in Queensland’s Brigalow Belt?

How much is a beetle worth (according to an economist)?

Which threatened species do we save first?

Trading high-value regrowth for high-value agriculture

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

Biodiversity and fossil fuel extraction
Designing carbon forests
Non-market valuation and policy
The history of an ‘outcome’
Separating outputs & outcomes

It’s not hard for the Environmental Decision Group to point to a stack of achievements such as the publication of high-impact science papers, the presentation of talks and the coordination of workshops. These are all important and worthy activities in themselves and they allow us to tick many of the boxes our funders require. However, in and of themselves, they are only a part of our value; some might say the lesser part. They are the outputs of our endeavours, and their real value lies in the outcomes that they bring about.

A paper on a new method that allocates scarce resources more efficiently between projects to save threatened species, for example, is an output. The implementation of that method by a government department, thereby saving more species, is an outcome. We discuss this very example on pages 4 and 5.

There are many definitions and descriptions of what outputs and outcomes are, and why they are different. I usually think of an output as the thing we produce, and the outcome is the difference this output makes. Of course, everyone has their own idea on this and the difference between outputs and outcomes is often blurry and contingent on your frame of reference.

For example, a workshop discussing conservation triage might be considered an output. A science paper that comes out of that workshop might also be thought of as an output. If the paper leads to a change in policy, these outputs might be considered as having contributed to an outcome. For the public servants involved, the policy is an output and the change created by that policy is the outcome.

However, if that workshop brought together public servants and scientists, and resulted in the creation of trusting relationships that endured over many years contributing to wise and informed policy development – well, that would also be a great outcome. Unfortunately, outcomes such as these are impossible to capture in the accounting sheet. Separating and valuing outputs and outcomes is never a straightforward process.

David Salt
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Our cover: A Yakka skink in poplar box regrowth, a woodland in Queensland’s Brigalow Belt. Regrowth has recently lost government protection in Queensland even though new research is demonstrating that it offers considerable value to biodiversity. Read all about it on page 8.

(Phot by Melissa Bruton)
Are protected areas maintaining bird diversity?

Evaluating the effectiveness of protected areas for sustaining biodiversity is crucial to achieving conservation outcomes. While studies of effectiveness have improved our understanding of protected-area design and management, few investigations (<5%) have quantified the ecological performance of reserves for conserving species. In an effort to increase our knowledge in this area, Laura Rayner and colleagues from ANU have presented an empirical evaluation of protected-area effectiveness using long-term measures of a vulnerable assemblage of species. They compared forest and woodland bird diversity in the Australian Capital Territory over 11 years on protected and unprotected areas located in temperate eucalypt woodland (matched by key habitat attributes). They examined separately the response of birds to protected areas established prior to 1995 and after 1995 when fundamental changes were made to regional conservation policy. Bird diversity was measured in richness, occurrence of vulnerable species, individual species trajectories and functional trait groups.

They found that protected areas were effective in maintaining woody vegetation cover in the study region, but were less effective in the protection of the target bird species assemblage. Protected areas were less species rich than unprotected areas, with significant declines in richness across sites protected prior to 1995. Small, specialised and vulnerable species showed stronger associations with unprotected areas than protected areas. Their findings indicate that recently established protected areas are more effective in the conservation of woodland bird populations than reserves established prior to 1995.

The study demonstrates that the conservation value of protected areas is strongly influenced by the physical characteristics, as well as the landscape context, of a given reserve and can diminish with changes in surrounding land use over time. Both protected areas and off-reserve conservation schemes have important roles to play in securing species populations.

Reference


Time preference for invasive species management

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Reference


Modelling restoration in agricultural landscapes

Landowner decisions about conservation initiatives are influenced by their values, beliefs and social norms. Understanding what drives landowner decision making and how these decisions impact biodiversity on privately owned land can better inform natural resource management.

In this paper, Sacha Jellinek and EDG colleagues demonstrate how Bayesian Networks can be used to integrate ecological and social data with expert opinion to model the cost-effectiveness of revegetation (for biodiversity) in agricultural landscapes. They demonstrate their approach with a case-study in the grassy woodlands of south-eastern Australia. In this study, cost-effectiveness was defined as the improvement in native reptile and beetle species richness achieved per dollar spent on a restoration action.

Socio-ecological models predict that weed control, the planting of trees and shrubs, the addition of litter and timber, and the addition of rocks are likely to be the most cost-effective actions for improving reptile and beetle species richness. The cost-effectiveness of restoration is lower in remnant and revegetated areas than in cleared areas because of the higher marginal benefits arising from acting in degraded habitats. This result is contingent on landowners having favourable attitudes. Under the best-case landowner demographic scenarios the greatest biodiversity benefits are seen when cleared areas are restored. They found that current restoration investment practices may not be increasing faunal species richness in agricultural landscapes in the most cost-effective way, and that new restoration actions may be necessary.

Integrated socio-ecological models support transparent and cost-effective conservation investment decisions. Application of these models highlights the importance of collecting both social and ecological data when attempting to understand and manage socio-ecological systems.

Reference

**The history of an ‘outcome’**

The science of conservation triage is becoming policy

*By Hugh Possingham (University of Queensland)*

Late last year, just before Christmas, we got another ‘outcome’! What’s more, this one came ‘gift wrapped’ in a front page story in the *Sydney Morning Herald*, making it easy for everyone to see.

What was that outcome? The NSW Government is adopting a version of ‘conservation triage’ that is based on our cost effectiveness approach – Project Prioritisation Protocol or PPP (see the box on ‘Saving our Species’). PPP basically involves ranking which projects for threatened species you’ll invest money in based on the cost, the likelihood of success and the benefit to the species. Of course, not everyone is happy with the idea of conservation triage (see the box on ‘the cold calculus of conservation triage’) but it’s easy to demonstrate that the approach can generate enormous benefits for biodiversity conservation.

In any event, outcomes from our research are always welcome, and not the least now as the National Environmental Research Program undergoes a mid-term review. It’s easy to point to outputs (meetings, workshops, science papers etc) but being able to say something led to an outcome (change in policy, new approach to management, the introduction of transparency to decision making etc), that’s something special, it’s something that takes time.

“But wait a sec,” I hear you say. “What’s this an outcome of? What meeting, workshop or paper led to this? Was it NERP or CEED money that generated this? Or did this come from that earlier funding version of ‘conservation triage’ that is based on our cost effectiveness approach – Project Prioritisation Protocol (or PPP). PPP basically involves ranking which projects for threatened species you’ll invest money in based on the cost, the likelihood of success and the benefit to the species. Of course, not everyone is happy with the idea of conservation triage (see the box on ‘the cold calculus of conservation triage’) but it’s easy to demonstrate that the approach can generate enormous benefits for biodiversity conservation.

The NSW Government is adopting a version of ‘conservation triage’ that is based on our cost effectiveness approach – Project Prioritisation Protocol (or PPP). PPP basically involves ranking which projects for threatened species you’ll invest money in based on the cost, the likelihood of success and the benefit to the species.

**The cold calculus of ‘conservation triage’**

Conservation triage is a sensitive topic because it forces people to acknowledge that we don’t have enough resources to save all threatened species; that choices have to be made. Invariably when the notion of triage is raised the question is asked: “So, which species are you giving up on?” Triage is associated with logic trumping feeling, of economics ruling the heart.

Consider the opening paras in the *Sydney Morning Herald* article:

“In a world dominated by big data and Google algorithms, we perhaps shouldn’t be surprised the fate of a species facing extinction can hinge on a mathematical equation. Tasked with trying to save almost 1000 threatened plant and animal species in NSW, the O’Farrell government is undertaking a version of ‘conservation triage’ where scarce funding will target species with the best chance of survival. Spending priorities will be ranked according to a cold calculus: the benefit of intervening to save a species, multiplied by the likelihood of success, divided by the cost.”

Describing conservation triage as ‘a cold calculus’ might make good copy but it also makes it harder to get risk-averse politicians to engage with the concept. If you think conservation triage based on cost-effectiveness is wrong, what’s your alternative? – inefficiently allocating funds? The previous situation (without triage) involved ad hoc, opaque decisions being made under the delusion that the available budget would secure the future of all threatened species. The consequences of this approach has been wasted resources, a growing list of extinctions and an inability to learn. Of the two approaches, which is rational and more moral?

We believe conservation triage is simply good decision making that requires no more than the mathematics of shopping – cost-effectiveness. In an age of catastrophic declines in biodiversity, surely we should be defending why we are not applying conservation triage, not justifying why it should be implemented.
During this phase of its development, our group was receiving funding from the Commonwealth Environment Research Facility program (CERF) and the Australian Research Council. The thinking involved many people and much discussion by collaborators like Mick McCarthy, Tara Martin, Kerrie Wilson, Eve McDonald-Madden, Stephen Garnett, Mark Burgman and David Lindenmayer – to name just a few.

In 2010 Tasmania adopted conservation triage underpinned by cost effectiveness (unfortunately they had no money to implement it). Around the same time, we started working with New South Wales on similar approaches following meetings coordinated by Sue Briggs.

In the last couple of years we have developed the protocol and associated software, and two new papers advancing the process are currently under review. These later stages of development have all been supported by NERP and CEED funding – indeed the tool and thinking are being refined continuously.

Other states and other countries are also expressing interest in the approach. And even the Australian Government is working with us on tailoring aspects of the process for national policy (14 years after I originally broached the topic with them).

Which all goes to show that assigning an outcome to any single grant or paper or person makes a mockery of the scientific process. It’s the accumulation of many discussions, papers, grants and meetings usually over multiple funding and policy cycles. I’d suggest a good piece of research usually takes around ten to twenty years before it starts producing outcomes of note. This is the norm in medical science, too. Of course there will be exceptions but, on the whole, no-one should think a good paper is going to produce outcomes in weeks, months or even years.

Returning to the success of PPP, New Zealand has been doing it now for about five years. Richard Maloney, a senior scientist with the New Zealand Department of Conservation says early results indicate “a fantastic improvement” on how things were done before. Now that’s a worthwhile outcome.

Reference

For a summary of this paper, see Decision Point #24.


For a succinct account of what PPP is and how it works, see Decision Point #29.

A view from the management coal-face

Richard Maloney is a senior scientist with the New Zealand Department of Conservation (DoC). He was instrumental in implementing PPP in New Zealand. Here he shares a few observations on how an outcome happens.

For a good account of what PPP is and how it works, see Decision Point #29.

How does something like the Project Prioritisation Protocol move from research to practice? My thoughts are that it always involves a combination of the science/academic support and the managers/technicians that make the approach happen, and a group of people who can act as ‘translators’ across these roles. Just publishing an academic journal article isn’t enough to get organisations to shift their practices to more cost-effective solutions. All large management agencies who work on threatened species are often balancing many competing and often undescribed needs. Successful implementation of tools developed generically, often need to be tailored to those requirements, or the organisation itself needs time to shift its structure to integrate new thinking. The process of taking great research tools and turning them into even greater management tools can be very challenging indeed.

In New Zealand many people had been thinking about the problem of the over-whelming volume of work and limited resources for threatened species management for many years prior to PPP. There had been investigations of a range of approaches, tracking the literature, developing ideas in group workshops, thinking at a range of scales (actions, species, ecosystems). All of these things contributed to the thinking behind the development approach that Shaun O’Connor and I took in New Zealand.

Based on our experience, I think there are four important components to moving an output (like PPP) to an outcome (an improved policy for conserving threatened species):

- A sound and mature statement and understanding of the problem that needs to be solved. (As a researcher – foster relations, embed yourself in management and even learn management language.)
- Robust defendable tools and approaches showing how the problem can be addressed. (Use meaningful case studies, provide support and interfaces to increase engagement.)
- Champions of those approaches to take out to support users. (Don’t stop after researching, developing and publishing a new tool or approach. Its only the start point for adoption by managers.)
- In-house champions who understand the nature of the problem that needs to be solved and who can translate the approach into their own organisation’s structure and culture and make it relevant to their own managers, scientists and field staff. (Find these people and work with them on tool implementation. They will have an in-depth understanding of their own organisation, and a good technical knowledge of the tool relevant to their own managers.)

Saving our Species launched in NSW

The Saving our Species program is a new NSW Government program that provides a coherent framework for the conservation of threatened species. It was launched in December 2013. The program engages the community to participate in threatened species recovery projects; aligns threatened species recovery effort across OEH and partners; and guides investment in targeted threatened species management actions.

Biodiversity and fossil fuel extraction

The other legacy of our energy consumption

By Nathalie Butt, Hawthorne Beyer & Leonie Seabrook (University of Queensland)

There's a global biodiversity crisis unravelling before our eyes and most of the major threats to biodiversity (such as habitat loss and invasive species) are being exacerbated by the growing impact of climate change. Science has convincingly demonstrated the connection between the burning of fossil fuels and climate change. Less well understood is the impact on our natural world of the actual extraction of these fossil fuels – coal, oil and gas.

A growing footprint

The process of extracting fossil fuels, which includes drilling and all forms of mining, has traditionally been seen as a temporary and spatially limited disturbance to an ecological system. In many cases it is assumed that some kind of restoration activity, often legally mandated, will return the ecosystem to a state close to its pre-disturbance state. Because of this, extraction activities have been considered trivial disruptors of natural systems in comparison with other human activities (such as agriculture). Indeed, in many countries extraction areas are considered 'borrowed' rather than 'consumed'.

The assumption of a relatively small disturbance footprint (for example, less than 0.05% of the land surface of Australia is disturbed by mining and mineral processing) has meant that it was previously easy to dismiss the environmental impacts of extraction as unimportant at larger scales. But should it be dismissed? In reality, ecosystem disturbance and degradation, as a direct or indirect result of extraction, has an increasingly large spatial footprint.

In order to meet demand driven by growth in incomes, consumption of goods and industrial development in major emerging markets, fossil fuel consumption is projected to increase dramatically by 2035: oil demand by more than 30%, and natural gas and coal demand by around 50%. As the most easily accessed reserves are depleted, attention is shifting to new areas and methods, such as coal seam gas and shale oil extracted by fracking. This threatens regions that are currently undeveloped and often highly biodiverse.

“...We identified two key areas most at risk from future fossil fuel development: northern South America (the Amazon Basin) and the western Pacific Ocean (the Coral Triangle)...”

Direct and indirect impacts

The direct impacts of fossil fuel extraction on biodiversity include the degradation of habitat at the local-scale, species loss, disturbance, fragmentation and edge effects; all of which can compromise ecosystem function at larger scales. The indirect effects of extraction, however, can have even more profound, large-scale impacts on biodiversity. The infrastructure required to support extraction (roads, airports, power lines, towns) facilitates further human development and a resulting cascade of impacts including land clearing, species invasions, and the illegal harvesting of wildlife. The third category of impact is the consequences of disasters (e.g., catastrophic oil spills).

So, given the distribution of known fossil fuel reserves and biodiversity, are there any areas that raise particular concern? We mapped the spatial overlap between areas of high marine and terrestrial biodiversity and reserves of fossil fuel. We also compared where high numbers of threatened species were in relation to reserves of fossil fuels (Figure 1). Based on this analysis, we identified two key areas most at risk from future fossil fuel development: northern South America (the Amazon Basin) and the western Pacific Ocean (the Coral Triangle).

Critical areas

The Amazon Basin, which covers eight countries in South America (Colombia, Peru, Ecuador, Bolivia, Venezuela, Suriname, French Guiana and Guyana) contains 10% of the world’s biodiversity and over 50% of its tropical forest. The Coral Triangle of Southeast Asia is the most biodiverse marine area of the world, containing two-thirds of the world’s coral species and one-third of the world’s species of fish (see box).

We also analysed the relationship between petroleum reserves and terrestrial species richness (Figure 2). This revealed four broad quadrants of threat level. Regions in the upper right of the figure (red) represent large reserves and high levels of biodiversity. These are areas of particular concern and included in this quadrant are Bolivia, Venezuela and Borneo.

Ecoregions such as North Burma, Senegal and Ecuador have medium-to-high species richness but are in areas of small petroleum reserves, so we would expect the pressure on biodiversity from fossil fuel extraction to be low. Regions with large petroleum deposits but low species richness (purple) are expected to experience habitat degradation and associated processes, but the net impact on biodiversity will be relatively small.

An international responsibility

There is an additional worry relating to these regions of concern. Many of the countries with high biodiversity where fossil fuel extraction is expanding suffer from poor regulation and enforcement. They also lack the ability to respond effectively to environmental disasters that are too frequently connected to the extraction of fossil fuels. Such regions may also be too
remote to attract media coverage and thus environmental damage caused in these areas may remain undetected and unaddressed.

It is essential that fossil fuel extraction in these regions takes place according to best practices, including rigorous environmental monitoring to ensure that damage is minimized. Recognition of the direct and indirect threats to biodiversity from fossil fuel extraction in these regions is essential in the establishment of suitable norms and processes which can guide controlled development so that environmental damage is minimised.

International environmental organisations could fulfil an essential role by ensuring that fossil fuel extraction takes place according to best practices and ideally avoids areas of high biodiversity. It is crucial that trade-offs between biodiversity conservation and development are properly assessed to ensure threatened or endemic species are not lost. International pressure can also help to ensure that any environmental damage that does occur is mitigated and the companies involved are appropriately penalised, as in the case of BP and the Deepwater Horizon disaster.

One possible mechanism to preserve biodiversity in fossil fuel-rich areas was recently attempted at Yasuní National Park in Ecuador. This highly biodiverse area also has the country’s largest oil reserves. In 2007 the Ecuadorean government proposed that in return for not extracting the oil from the park, and keeping the forest biodiversity, they would be compensated. The funds were to be raised through the international Green Climate Fund (UNFCCC), to the value of $3.6 billion, about half the value of the oil.

Ten per cent of the money was raised, from countries, regions, corporations, foundations and individuals, to be invested in renewable energy projects. Unfortunately, due to lack of global commitment, the project failed. Oil extraction will now go ahead. With strong international support, schemes such as this could be a way of protecting biodiversity in fossil fuel rich areas.

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Reference

Reptiles in the regrowth

What’s the value of regrowth vegetation?

By Melissa Bruton & Clive McAlpine (University of Queensland)

Last year the Queensland Government introduced legislation that removed protection for several categories of regrowth vegetation. Previously, regrowth which had not been cleared since 1989, and occurred in ecosystems with less than 30% of their original extent remaining, was protected from most clearing activities (Queensland Government, 2011). This protection has now been removed. WWF has calculated that, as a result of these changes, 700,000 ha of previously protected high-value regrowth can now be cleared for ‘high-value agriculture’ in Queensland (Taylor, 2013). These changes suggest that production has absolute priority over biodiversity and ecosystem function. Many claim these changes represent a significant blow to biodiversity and ecosystem restoration in Queensland.

This begs the question, why were these regrowth protections set up in the first place? At the end of the 20th century, vegetation in Queensland and New South Wales was cleared at rates similar to the rainforests of Brazil. In fact, for most of the 20th Century it was a condition of holding a lease, that the lessor cleared a proportion of the leased land to ensure they retained the lease. This program was so effective that by the turn of the 21st century, 45% of Queensland’s regional ecosystems were reduced to less than 30% of their original extent; a level that puts those ecosystems at risk of losing biodiversity and function. In 2004, Queensland enacted new vegetation laws that significantly reduced the rates of clearing. The thinking at the time was that the only way to increase the extent of these threatened ecosystems was to protect regrowth and allow it to mature.

“...When the goal is to increase biodiversity in a disturbed landscape, passive regrowth woodlands offer cost-effective and valuable complementary habitat to remnant woodlands.”

Excellent restoration potential

The most heavily cleared areas of Queensland are the woodlands of the Brigalow Belt Bioregion. Australian woodlands possess a rich diversity of reptiles, and reptiles are an important component of these nutrient-poor ecosystems because they ensure energy and nutrient flow between invertebrates and higher order predators. Our research in the Brigalow Belt Bioregion has shown that there is no difference in the diversity, dominance and composition of reptile communities in regrowth and remnant woodland (Bruton et al., 2013).

In fact, reptile communities in regrowth woodlands were indistinguishable from their corresponding communities in remnant woodlands. The most interesting part is that the regrowth...
woodlands in our study were relatively young – between 10 and 23 years old – with only half the canopy height of remnant areas. In other words, for the reptiles we studied, regrowth doesn’t have to be ‘old’ to possess equivalent habitat value to remnant vegetation.

Queensland’s woodlands are dominated by acacias (wattles). The Brigalow Belt, for example, is named after one of its common wattles, Acacia harpophylla, or Brigalow. Acacias naturally sucker (send up shoots from roots left in the ground). This means a cleared site can quickly regrow, offering cost-effective, large-scale opportunities to restore ecosystems and reduce the biodiversity declines that have been caused by the over-enthusiastic clearing of vegetation. By comparison, many of the restoration efforts in southern Australia, and other parts of the world, require planting and follow up management, which generally limits them to small-scale efforts.

Achieving global restoration targets

Developing cost-effective restoration programs for threatened ecosystems will become increasingly important if the world is to meet the United Nations target of restoring 150 million ha of disturbed and degraded land globally by 2020 (a target endorsed at the 2012 United Nations Rio+20 Conference on Sustainable Development, see Decision Point #68).

When the goal is to increase biodiversity in a disturbed landscape, passive regrowth woodlands offer cost-effective and valuable complementary habitat to remnant woodlands. Our finding that regrowth is a high value habitat for reptile communities provides valuable information that will assist in the cost-efficient recovery of highly modified and reptile-rich subtropical woodland regions. In addition to the Brigalow Belt of Australia, these regions include the Chaco and Cerrado of South America; regions that also have been identified as opportunity areas for landscape restoration as part of the United Nations restoration goal.

The former vegetation management laws in Queensland acknowledged the financial value of passive regrowth vegetation by protecting regrowth areas in threatened ecosystems from clearing, allowing them to regenerate naturally. Unfortunately, the recent reforms by the current Queensland Government removed this legal protection.

What’s the trade-off?

The protection of high-value regrowth in Queensland has been traded for the expansion of ‘high-value agriculture’. However, at no point in the Vegetation Act 1999, or subsequent amendments, is ‘high-value agriculture’ defined. So what are we really trading?

Some definitions in the scientific literature suggest ‘high-value agriculture’ relates to ‘non-traditional food crops which have a higher commercial value’. Our only traditional food crops in Australia are the macadamia nut and bush Tucker. Does this mean that ‘high-value agriculture’ refers to all other agriculture? It’s hard to know without the state government providing a formal definition, but if it is referring to all non-traditional agriculture then these reforms have effectively removed all protection from high-value regrowth.

If we take a commercial approach and define ‘high value agriculture’ as the top five Australian agricultural exports (by value) for the last financial year (2011-2012), then we are looking at wheat, beef, cotton, wool and wine. If so, then once again, the changes have effectively removed protections for the vast majority of high-value regrowth in Queensland, particularly for the woodlands of the Brigalow Belt and Mulga Lands Bioregions.

In either case, it would seem that scientific consultation regarding the impacts of the proposed amendments to regrowth legislation on agricultural production, the environment and society, have not been considered evenly, or in any depth. Studies such as ours are suggesting there are strong arguments to protect high value regrowth in the interests of biodiversity conservation.

Reptiles and remnants

Whilst our findings demonstrate that passive regrowth areas can effectively contribute to the amount of high quality habitat available for reptile communities in disturbed subtropical woodlands, the conservation of existing woodlands must always be considered a priority.

The sites that we surveyed in disturbed areas (cleared and regrowth) during this study were all within 700 m of remnant woodlands. Therefore, the opportunity for recolonisation from remnant vegetation was high in both cleared and regrowth sites. However, cleared sites remained species poor, confirming that these areas are not suitable habitat for most woodland reptile species.

In contrast, regrowth woodlands were recolonised at the time of our surveys. These findings suggest that regrowth areas that are adjacent to remnant woodlands should be prioritised for protection. Currently, there is insufficient landscape-level information available about the dispersal of reptiles across different matrices to determine if isolated regrowth areas are able to support a functional assemblage of woodland reptiles.

However, from what is now known about reptiles in subtropical woodland regrowth, we believe there is a compelling case to reinstate the legislative protection that has recently been overturned.

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References


Designing carbon forests

Do tree mixes stack up to monocultures in carbon plantings?

By Kris Hulvey and Richard Hobbs (University of Western Australia)

The developing carbon market has created incentives to plant forests that offset carbon emissions. But what types of forests should we plant? Will monocultures of fast-growing trees like those used in the timber industry maximize carbon storage or is there another option?

Our research team has been particularly eager to explore this question in relation to processes such as Australia’s Carbon Farming Initiative (CFI). This Initiative provides both guidance and monetary incentives to landowners interested in growing trees to generate carbon offsets. While approved methodologies include those that allow either mixed species plantings or monocultures, looking across the Australian landscape, many forests planted for carbon adhere to the one-species model.

This may be due, at least in part, to a perception that single species plantings sequester more carbon than mixed plantings. However, few ecological studies have examined the contribution of tree diversity – in particular tree richness and composition – to carbon sequestration and storage. While our research group in Western Australia has set up a large experiment to do just this (See Perring et al. 2012), growing forests to sequester carbon takes decades. Hence, we decided to examine how tree diversity might affect carbon storage by compiling data from existing studies (Hulvey et al., 2013).

Comparing forests

In the case of carbon plantings, project developers will only likely plant tree mixtures in lieu of monocultures if the mixes sequester more carbon than monocultures – including the most productive monoculture planted in a landscape. Thus one of our study questions was: Do tree mixtures store at least as much aboveground biomass as their most productive species grown in monoculture?

Because few studies directly examine tree diversity’s contribution to carbon sequestration and storage, we used stand above-ground biomass (ie, tree stems and branches) as a proxy for carbon storage in planted forests. We then used meta-analysis to compare biomass production in mixed tree plantings to that in monocultures.

We reviewed over 150 studies from the biodiversity-ecosystem functioning and forestry literature, but narrowed this pool to eight studies via a couple of criteria. The most important of these were that studies needed to report data from tree monocultures and mixes that were grown at the same site – this eliminates productivity differences stemming from abiotic conditions. In addition, studies needed to have designs that distinguished between density and diversity effects to avoid confusing diversity effects with biomass increases stemming simply from planting more trees in a stand. From the eight studies that met all criteria, we were able to use 18 unique comparisons of the biomass produced in tree-mixes to that produced in monocultures.

Do monocultures maximize carbon sequestration?

Although tree monocultures are one option for storing carbon in forests, our analyses suggest that increasing tree diversity in carbon plantings can increase carbon storage through the production of more above-ground biomass. We found that tree-mixes produced at least as much biomass as monoculture plantings comprised of the single most productive species in the mixture. Additionally, in some situations, mixes outperformed monoculture plantings, producing on average 17%-18% more biomass than plantings consisting of a single productive species (figure 1). These findings suggest that monoculture plantings are not the only choice when planting forests to create forest offsets.

What’s more, we found that including key species in these more diverse tree mixes can facilitate stand growth, likely leading to higher carbon storage. In particular, nitrogen-fixing trees increased stand biomass. Managers that employ single fast growing tree species in carbon plantings already recognize that tree identity is critical to maximizing carbon yields. Our results highlight that some tree species may work in synergy with other trees to maximize carbon storage. In the case of nitrogen fixing species, these trees may facilitate the growth of nearby trees by providing additional soil nitrogen.

“...mixed plantings produced on average 17%-18% more biomass than plantings consisting of a single productive species.”

Monocultures of trees (an example is pictured above), have traditionally been the choice when it comes to establishing plantations. New research is suggesting, however, that mixed plantings can match monocultures when it comes to locking up carbon. What’s more, mixed plantings also have the capacity to deliver multiple other benefits as well.

A mixed tree planting at Ridgefield multiple ecosystem services experiment on the UWA Future Farm, east of Perth, Western Australia. Trees and shrubs were planted in 2010 in 25x25m plots in different combinations ranging from 1 to 8 species. The land was previously grazed or cropped land. (Photo by Kris Hulvey)
Accounting for nonmarket costs and benefits should be encouraged to enable a more systematic, rational process for allocating government funds. Consequently, our research suggests a two-pronged strategy for designing carbon plantings including: (1) increased tree species richness; and (2) the addition of key species that contribute to carbon storage. More research on the mechanisms leading to increased productivity in mixed-tree stands can further enhance our understanding of the best planting designs in carbon forests.

Other benefits

While the main goal of current carbon projects is to optimize carbon sequestration and storage, tree species diversity may provide other benefits as well. For example, biodiversity theoretically favours functional stability, and many studies in grasslands show that biomass production is more stable in diverse communities. For mixed-tree plantings, this may translate to greater resistance and/or resilience to disturbance events like pest outbreaks as well as to slow directional changes such as from climate warming or atmospheric nitrogen deposition.

Mixed forests may also increase the potential for carbon plantings to provide additional ecosystem services beyond carbon storage. Research on ecosystem multi-functionality indicates that diverse species assemblages are more likely than monocultures to provide high levels of multiple functions simultaneously. In the case of forests, people are also interested in protecting habitat for biodiversity, and demand for projects that both sequester carbon and protect biodiversity have more than doubled between 2011 and 2012.

Most importantly, our work suggests that monoculture plantings are not always the only choice when planting forests for carbon storage. Studies that build on this result by examining how climatic and abiotic conditions interact with species diversity to contribute to carbon storage will be critical to advancing carbon project design. Importantly, however, we may miss opportunities for carbon plantings to achieve several goals simultaneously if research focuses solely on diversity’s contribution to carbon sequestration in aboveground biomass while neglecting its contribution to additional benefits that also arefavoured by diverse carbon plantings.

Overall, a better understanding of how tree diversity affects carbon storage will be useful for designing carbon projects that both store large amounts of carbon and have additional ecosystem benefits.

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References


Of carbon banks and trees

A carbon bank built on trees can yield rich biodiversity returns yet these returns come with significant risks. Consider these two stories in previous issues of Decision Point.

A bigger and safer carbon bank

“The green carbon in natural forests is stored in a more reliable stock than that in industrialised forests, especially over ecological time scales.”

Decision Point #22

Bioperversity in the plantation

“A narrow focus on carbon storage has the potential to create significant negative environmental outcomes if the protection and enhancement of other values such as biodiversity are not explicitly considered.”

Decision Point #62
Research on non-market valuation – what is it good for?

Environmental managers and intangible values in policy decisions

By Abbie Rogers, Fiona Gibson, Marit Kragt, Michael Burton, Elizabeth Petersen and David Pannell (University of Western Australia)

The Australian Government’s Best Practice Regulation Handbook is “committed to the use of benefit-cost analysis to assess regulatory proposals to encourage better decision making”. But how do you factor in the value of a bird, a beetle or an area of bush in a benefit-cost analysis? Coming up with dollar values for ‘non-market’ components of the environment has always been challenging. One technique that is commonly used to obtain a value for these things is non-market valuation (NMV), and there’s been a lot of research on how to do it (thousands of peer-reviewed publications in Scopus since the 1960s). With so much effort being devoted to it, you’d expect that NMV research would be having a significant influence on environmental decision making in Australia, but does it? We (a group of researchers in the Centre for Environmental Economics and Policy at the University of Western Australia) decided to find out what influence the research has had.

Non-market valuation is an economic technique to estimate the intangible values of the environment through hypothetical markets. For example, it might aim to elicit how much people are willing to pay for a particular conservation program that might save an endangered animal (for example, see the box “NMV and the sawfish”).

NMV is usually done through extensive community surveys where individuals state their preferences. The resulting values can then be used in benefit-cost analysis or other tools which contribute to decisions on how to get value for money in conservation or restoration projects.

Are decision makers using non-market valuation?

So, how did we determine the influence of research on NMV to environmental policy? We asked people involved in environmental policy how they used it. Telephone interviews were conducted with decision makers in Australian environmental organisations and agencies towards the end of 2012. We also conducted an online survey of NMV experts, including academics and consultants, from Australia and New Zealand. The survey and interviews provided information about: (a) the extent to which NMV results are used by decision makers in environmental programs; (b) reasons for the use or non-use of NMV; and (c) differences in perceptions about these matters between NMV specialists and environmental decision makers.

We found that:

• When researchers were asked to provide information on their studies which they perceived had influenced policy, tangible evidence of impact on policy could only be provided in 20% of the cases (most commonly, the evidence was that values were included in a benefit-cost analysis). In 32% of cases, the researchers conceded that they were not aware of the study having made a clear difference to a decision.
• 37% of decision makers had used NMV at least once, while 63% couldn’t name a single NMV technique.
• Around 50% of environmental decision makers had never used information from any type of economic analysis.
• 76% of decision makers perceived NMV to be a potentially useful decision support tool.

Our findings suggest that NMV is mostly used to support decisions ex post (after the fact), rather than to inform the decision making process a priori (before the process). For example, results may be used to “…justify

NMV and the sawfish

What’s the value of protecting the endangered freshwater sawfish found in the Kimberley’s tropical waterways? A non-market valuation study involving an extensive survey of West Australians found that the West Australian community were willing to pay between $43 and $47 per year, per household, for a five year period. As an aggregate of West Australian households (using 2009 statistics), this equates to about $38 million a year, or $190 million over the five years. This is much greater than the estimated costs (based on expert elicitation) for protecting single species in the Kimberley and can be used in framing policies for environmental protection.

Non-market valuation should be seen as a ‘friend’ of conservation prioritisation. It fosters better decision making by including the community benefits of conservation action and can often provide a stronger justification for government intervention and investment. Even if the valuation indicates that the values of a particular environmental asset are not high enough to justify a particular investment, it is information that helps us to target our limited conservation resources to the most valuable outcomes.

See Decision Point #60 for story on this NMV research.
additional expenditure on protecting native species...” or “…support limits on water allocations...”

Barriers to better usage

While ‘justifying’ decisions after the fact can be important, it’s clear from these results that the full value of using NMV research in the decision making process is not being realised. Why is it that the results of NMV are only being used in a minority of situations?

Based on the results of our surveys, important barriers to using NMV in environmental decision making were the general lack of awareness and understanding of NMV; lack of time and resources; and general opposition to using economics or monetising the environment (consider the story “Objections to decision science” in Decision Point #74). For example, one interviewee stated that “many people within environmental agencies are highly sceptical of the value of economic studies”.

Interestingly, communication was mentioned by researchers as an important instrument to improve decision makers’ awareness of NMV. Although some researchers understood ‘communication’ as engagement with the decision body during the research, or presenting results to the decision body, there were also researchers who reported communication in the form of peer-reviewed publications. In reality, academic papers in peer reviewed journals are rarely read by policy decision makers.

Our study revealed little evidence of NMV studies making a difference to environmental decision making in Australia. The majority of environmental NMV studies are not used in ‘real-world’ decisions. Where they are used, they tend to justify existing decisions, rather than inform a decision making process. Using NMV as a justification is unlikely to generate the social benefits that can potentially be achieved if NMV results were used instead as an input to choosing the most efficient environmental project. By that we mean choosing the investment of scarce environmental funds that result in the greatest (tangible and intangible) net benefits.

On the other hand, some decision makers were positive about NMV. For example: “I’m increasingly impressed by the value in undertaking these studies. It’s really good evidence for us to help influence decision makers”; and “the [decision makers’] understanding and appreciation for these techniques continues to increase”.

Given that the use of NMV in policy is not a requirement, an obvious question arises, “how do decision makers account for intangible environmental values?” Our view is that the tools of economics – including benefit-cost analysis and NMV – provide useful decision frameworks to incorporate economic values into environmental planning.

Increasing the use of NMV in decision making

Accounting for nonmarket costs and benefits should be encouraged to enable a more systematic, rational process for allocating government funds. We acknowledge that NMV results are not precise, and that uncertainties about environmental values remain. However, uncertainty is present in all information inputs to decision making. Fortunately, as discussed in Decision Point #74 (“Objections to decision science”) we have many ways of accounting for uncertainty in decision-making. Thus, uncertainties in all aspects of environmental projects (such as risks that management actions are not fully effective at improving environmental outcomes) will need to be considered when evaluating the best use of scarce government funding.

Our results highlight a lack of knowledge on both sides of the researcher-policy divide. Many of the decision makers interviewed had a profound lack of knowledge about NMV. However, an encouraging result of our study is that the interviewed decision makers do generally have a positive attitude towards the concept of NMV, which may improve with increased awareness of the methodology.

If we can increase the knowledge about NMV techniques within decision making bodies, there may well be an increased appreciation for these techniques, and the rigour that NMV can bring to decision making. Based on the findings of the study, we have drawn a number of recommendations that researchers can follow to improve the use of their NMV research in decision making (see the box on “Making more of NMV”).

Making more of NMV

Researchers wanting to improve the use of their NMV research might consider the following list of activities. How many of these do you engage with?

Understand the policy world

For example, know the key players and network, and realise that the costs and benefits of obtaining information may be high.

Communicate well

Be clear, brief and simple, and avoid jargon, acronyms and technical issues. For example, communicate through Policy Briefs or presentations rather than only relying on academic publications.

Collaborative research

Involve decision makers in the research process from an early stage.

Be pragmatic

Know what is realistically possible in policy.

Be timely

Timeliness is important – be prepared to respond quickly if needed for a policy decision.

Empower policy people

Offer training and support to (environmental) decision makers to raise their awareness and knowledge about NMV and benefit-cost analysis. Making efforts to include relevant economics in undergraduate environmental science degrees may also be a worthwhile long-term strategy.

Improve economic literacy

Often, environmental decision makers do not know how to use economic information because there is no place for it in the decision processes used. Provision of simplified decision systems or tools that can incorporate NMV results may help to overcome this barrier. An example of an attempt to do this is INFFER (Investment Framework for Environmental Resources – see Decision Point #55).

“Tangible evidence of impact on policy could only be provided in 20% of the cases.”
Movement science and biodiversity policy

A NERP ED Workshop
(Mollymook, September 2013)

By Pia Lentini (UMelb), Annabel Smith (ANU) and Philip Barton (ANU)

The movement of organisms has a fundamental influence on the distribution of biodiversity. Movement affects community structure and ecological phenomena such as reproduction, resource availability, genetic diversity, food webs, and species interactions. Anthropogenic disturbances and inappropriate management can disrupt these important processes, so movement information should be considered in conservation decisions. For example, it’s critical to consider how species might disperse across a protected area network to ensure gene flow, where nomadic species could seek refuge during drought, whether suitable habitat is available for vectors and pollinators of threatened plant species, or how to inhibit the movement of a threatening process, such as an invasive predator.

However, a recent review indicated that despite rapidly escalating research on connectivity, there remains a dearth of information on species movement. In light of this, a workshop funded through the National Environmental Research Program (NERP ED) and run by three early career researchers was held in Mollymook (south coast of NSW) in September. The broad aim was to identify the relevance of movement information to a range of government policy and management issues and develop a framework for managing uncertainty when making environmental decisions. The workshop was attended by four staff from the Commonwealth Department of the Environment (Environmental Assessments and Compliance; Sustainability Analysis and Policy; Parks Australia; and Wildlife Heritage and Marine) and 11 academics from across the ANU, the University of Melbourne, the University of Queensland, and the Hebrew University of Jerusalem.

Participants split into two groups to address two key issues. The first group assessed and developed a conceptual framework for managing uncertainty when making environmental decisions. The workshop was attended by four staff from the Commonwealth Department of the Environment (Environmental Assessments and Compliance; Sustainability Analysis and Policy; Parks Australia; and Wildlife Heritage and Marine) and 11 academics from across the ANU, the University of Melbourne, the University of Queensland, and the Hebrew University of Jerusalem.

Participants split into two groups to address two key issues. The first group identified environmental decision-making domains where movement information is most relevant, with a view to providing advice to both sides of the policy-science interface on how to effectively share information. This group also identified emerging areas of biodiversity policy that might benefit from movement knowledge.

The second group developed a conceptual framework for managing the two types of uncertainty encountered within these decision-making domains: the relevance of movement to the environmental decision, and information on movement itself. During this process Department staff provided policy case studies and decision scenarios, which were extremely valuable in providing context so that researchers could ensure that the approaches taken were realistic and relevant.

This was one of eleven workshops funded through a NERP ED scheme which targeted issues specifically being driven by early career researchers (often referred to as ECRs). It enabled ECRs to engage not only with leading academics in the field but also with officers from the Department of the Environment. This helped researchers to learn more about the inner working of the Department of the Environment, and policy makers to better understand where our research would be most useful. It also allowed Departmental staff to increase their knowledge of research themes relevant to movement science and biodiversity conservation, and identify key investigators working on those themes.

It’s hoped that the new collaborations arising from this workshop will enable movement science to better inform policy in a range of areas (for example in connectivity and restoration policy). Papers emerging from this workshop should be available over the coming year.

And just as a post script on the workshop, Ran Nathan from Hebrew University Jerusalem (and possibly the world’s foremost expert on movement science) commented it was one of the most worthwhile workshops he’d ever attended.

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Trade-offs between carbon farming and biodiversity

A CEED/NERP workshop
(UWA November 2013)

By Marit Kragt (UWA), Fleur Maseyk (UQ), Louise Blackmore (UWA)

Under the Carbon Farming Futures Programme, rural landholders have the potential to generate carbon credits through activities such as agroforestry, re-vegetation of land or changed agricultural practices. Each of these activities may have positive or negative effects beyond their intended mitigation of climate change (externalities or co-benefits). For example, tree belts can have a positive impact on crop productivity in neighbouring fields, or native tree plantations can increase the availability of native habitat.

If carbon farming proposals are evaluated only on their carbon mitigation potential, there is a risk that management creates ‘perverse’ outcomes (eg, by supporting activities that have negative impacts on biodiversity). There are many, and often complex, costs and co-benefits that should be taken into account when assessing different carbon farming mitigation options. If we are looking to achieve multifunctional landscapes, we need to assess the carbon mitigation as well as the co-benefits of carbon farming. Unfortunately, there are still many gaps in our understanding about carbon sequestration, the co-benefits provided by carbon farming activities, and the tradeoffs between different impacts.

This workshop, set in the leafy grounds of the University of Western Australia, brought together various players working on this issue from around Australia. We aimed to create valuable collaborations and produce useful research outputs. The workshop drew together ecologists, economists, social scientists, modellers, foresters, policy officers and carbon consultants; all sharing their insights on how farming for carbon and farming for biodiversity can be understood, measured and traded off.
Dbytes

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

1. A Guide to Non-Market Valuation

Released in January 2014, this report from the Productivity Commission examines the validity and reliability of various non-market valuation methods, the case for using non-market valuation in environmental policy analysis, and how best use can be made of non-market valuation in developing environmental policy. (Plus see our story on page 12.)

2. Saving our Species program in NSW

The Saving our Species program is a new NSW Government program that provides a coherent framework for the conservation of threatened species. It was launched in December. The program aligns threatened species recovery effort across OEH and partners; and guides investment in targeted threatened species management actions.


The Bureau of Meteorology has released its Guide to environmental accounting in Australia. The Guide aims to improve environmental outcomes in Australia and contribute to the country’s long-term sustainability through the implementation of environmental accounts, and is intended as a bridging document for policy makers, scientists and accounting practitioners.

4. The value of Environmental Citizen Science

Citizen science’s value for science, society, education and environmental policymaking are considered in this In-depth report, which explores academic research into citizen science practice and theory and outlines a number of case study projects. Overall, the report finds its potential value is high, but remains largely untapped.
http://ec.europa.eu/environment/integration/research/newsalert/indepth_reports.htm

5. Regional-scale Environmental Condition Accounts

Wentworth Group of Concerned Scientists report on Constructing Environmental Asset Condition Accounts

6. Sceptical Climate

A report on the media coverage of climate change in Australia from the Australian Centre for Independent Journalism. This report looks at coverage of climate science in ten Australian newspapers between in 2011 and 2012 and asks: What is the quality and nature of climate science reporting in Australia?

Mixed species plantings have been established in many parts of Australia. Some were set up as experimental plantings, some as environmental plantings and others as commercial plantings. The carbon/biodiversity workshop brought together several of the players working in this space. The hope is that their collaboration will fill many of the knowledge gaps identified during the workshop.

The two days involved brief research presentations and stimulating discussions between the participants. The main themes that emerged from the discussions included the spatial mapping of co-benefits; appropriate mechanisms to incentivise biodiverse carbon farming; an examination of what we’ve learned from the various multi-species planting experiments across Australia; drivers and barriers of participating in carbon farming; the willingness to pay for the multiple benefits of carbon farming practices; defining metrics for measuring biodiversity and carbon values; avoided deforestation as a method to meet national carbon sequestration goals; and the potential role of insurance providers as important players in the voluntary carbon offset market.
Responding to these themes is challenging, not least because they require interdisciplinary collaboration. Workshops like these are helpful to increase mutual understanding, and can help to develop a shared language required to progress inter-disciplinary research. We formed a number of multi-disciplinary teams that will each work on a theme. Plans were drawn up on how each topic would be tackled over the coming months. In March 2014, there will be a follow-up workshop in Brisbane to further exchange ideas and enable the various projects to be written up.

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David Freudenberger (left) discusses lessons learnt on mixing carbon with biodiversity plantings down on the Gondwana Link.
What’s the point?

Food for thought

William Ripple and colleagues (including EDGite Clive McAlpine) reckon there’s a massive source of greenhouse gas emissions out there that has largely been ignored by policy makers – 3.6 billion domestic cattle, sheep and goats (Ripple et al, 2014). In an article in *Nature Climate Change*, they point out that the methane produced by these ruminants through enteric fermentation is no insignificant burp. Globally, ruminants contribute 11.6% of all greenhouse gas emissions from anthropogenic sources. The total area dedicated to grazing encompasses 26% of the terrestrial surface of the planet.

“Ripple and co suggest that in addition to tackling greenhouse emissions, reductions in ruminant numbers and ruminant meat production would simultaneously benefit global food security, human health and biodiversity conservation. What’s more, with political will, decreases in worldwide ruminant populations could be accomplished quickly and relatively inexpensively.

Meat production, by the way, is set to double by 2050, so this is not an issue that our leaders are actively dealing with at the moment. The scientists conclude their commentary with the plea: ‘we need to increase awareness among the public and policymakers that what we choose to eat has important consequences for climate change.’

Reference