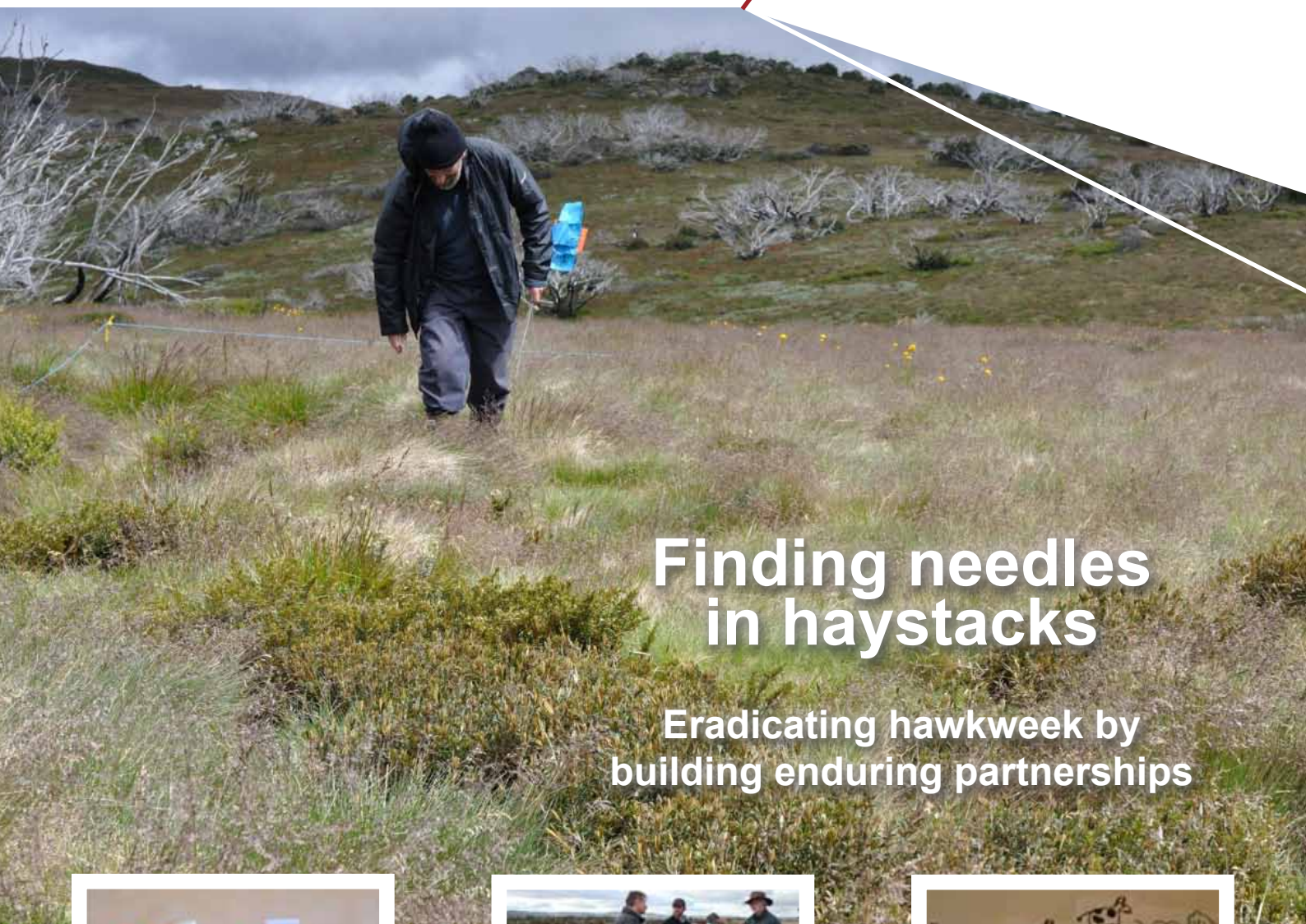


DECISION POINT

Connecting conservation policy
makers, researchers and practitioners

Issue #80 / July 2014



Finding needles in haystacks

Eradicating hawkweed by
building enduring partnerships



**Imperfect detection in
legoland**



**Offsets assessment and the
science-policy divide**



**The matrix in ecology
(and selling science
through videos)**

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

Biodiverse carbon plantings on Indigenous land
Strategic planning and cumulative impacts
Integrating social values into conservation plans
Adaptive management for species introductions

DECISION POINT

Issue #80 / July 2014

Contents



Research briefs 3

- ▶ Counting species is an inaccurate science
- ▶ Inferring extinctions from sighting records
- ▶ Decisions about commercially valuable invasive species

The matrix reloaded 4

Don Driscoll on selling complex ideas in ecology.

The Great EDG 2014 Video Competition 5

Six fabulous finalists - two outstanding winners.

Victoria's hawkweed eradication program 6

How an enduring alpine partnership controlled a devilish invader.

Carbon plantings on Indigenous land 8

Anna Renwick looks at what's possible for biodiversity? What's optimal?

Socially-acceptable cons planning 10

Integrating biological and social values to improve conservation.

Developing an offsets assessment guide 12

The many benefits of bridging the science-policy divide.

Workshops 13

Adaptive management for species reintroductions (p13); tools for NRM and monitoring (p14); marine conservation planning in a changing world (p15).



A volunteer seeks hawkweed in a detection experiment. The challenges of controlling an invasive species like hawkweed are formidable. A partnership between academia, NRM and government demonstrates how it is being achieved. See the story on page 6. (Photo by Roger Cousens).

On the point

Beginning at the end

If you read this issue backwards (from back to front from page 15), there's an interesting thread that reveals something about the science of EDG.

Much of our science begins with workshops around themes of common interest. Sometimes these discussions begin with big questions like: What are the big questions for marine conservation planning in a changing world (p15)? Sometimes these discussions occur further down the road and are more about refinements on a specific process such as: How can we apply adaptive management better for the reintroduction of species (p13)?

These workshops invariably lead to multiple working groups who go out to explore the potential of different approaches raised at the workshops. Again, the exploration might be broad such as investigating the utility of integrating social values in conservation planning (p10). Or it might be answering a specific question like what's possible and what's optimal when it comes to establishing biodiverse carbon plantings on Indigenous land (p8)?

The best science, in terms of conservation outcomes, is that science done in collaboration with stakeholders because then the research usually directly informs management actions. Our story on eradicating hawkweed from our precious alpine ecosystems demonstrates what's possible when excellent science lies at the core of a science/management partnership (p6). This is connected science producing good results in real time.

But how do you tell the world about your science when that science is complex and normally only served up in impenetrable academic journals? One answer is to turn your research into a plain-speaking video. And that's exactly what a group of EDG researchers (from across our network) have done. Don Driscoll describes his own personal journey in becoming a video producer and then discusses our inaugural EDG video competition and our six finalists (p4).

Of course, you don't have to read Decision Point backwards to realise its full potential but sometimes it's worth remembering that the workshop reports that appear at the end are really only the beginning.

David Salt
 Editor,
 Decision Point
David.Salt@anu.edu.au

DECISION POINT

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

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

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

Counting species is an inaccurate science

Knowledge of the number and distribution of species is fundamental to biodiversity conservation efforts, but this information is lacking for the majority of species on Earth. Consequently, subsets of taxa are often used as proxies for biodiversity; but this assumes that different taxa display congruent distribution patterns. For example, one method is by counting a well-known group, such as birds, and assuming they represent the diversity of other groups.

A group of researchers at ANU, led by Martin Westgate, has compared many of these different estimation methods to test their validity. They whittled down over 8,000 biodiversity papers to 81 papers that could be directly compared. Their comparisons found a serious lack of consistency between the different assessments of biodiversity. In particular, they found that studies at different latitudes or spatial scales rarely find similar results, even when they consider the same groups of plants or animals.

These results undermine the assumption that a subset of taxa can be representative of biodiversity. Therefore, researchers whose goal is to prioritize locations or actions for conservation should use data from a range of taxa. 🍌

Reference

Westgate MJ, PS Barton, PW Lane & DB Lindenmayer (2014). Global meta-analysis reveals low consistency of biodiversity congruence relationships. *Nature Communications* 5:3899. DOI: 10.1038/ncomms4899

Inferring extinctions from sighting records

The decision of declaring a species has gone extinct is critically important to conservation management (see [Decision Point #38](#)). A range of mathematical models has been developed to infer whether a species is extinct based on a sighting record. Although observations have variable reliability, current methods for detecting extinction do not take this variability into account.

To rectify this, Tamsin Lee and colleagues have developed an approach, based on a Bayesian method, that consider certain and uncertain sightings throughout the sighting period. They then applied their method to estimate the probability of whether the Caribbean seal, black-footed ferret, greater stick-nest rat and lesser stick-nest rat are extinct. As further examples, Birdlife International provided the sighting records for the Alaotra grebe, Jamaica petrel and Pohnpei mountain starling with prior probabilities for extinction. Their results were compared with existing methods, which ignore uncertain sightings. They found that including uncertain sightings can considerably change the probability that the species is extant, in either direction. However, in these examples, including the quality of the uncertain sighting made little difference. However, when uncertain sightings are ignored, their results agree with existing methods.

Estimating the probability that a species is extinct based on sighting records is important when determining conservation priorities and allocating available resources to management. Having a model that allows for certain and uncertain observations throughout the sighting period better accommodates the realities of sighting quality, providing a more reliable basis for decision-making. 🍌

Reference

Lee TE, MA McCarthy, BA Wintle, M Bode, DL Roberts & MA Burgman (2014). Inferring extinctions from sighting records of variable reliability. *Journal of Applied Ecology* 51: 251-258.

Decisions about commercially valuable invasive species

The management of introduced species that are both invasive and commercially valuable is contentious. While such species provide substantial economic benefits to some, they pose considerable costs to others due to negative impacts on ecosystems. Consider, for example, the case of buffel grass. In rangelands worldwide, buffel grass is amongst a suite of commercially valuable invasive species, highly valued by some graziers as a pasture species but widely unpopular among those concerned with the threat it poses for native biodiversity.

Isabelle Grechi and colleagues have proposed a decision framework to help balance conflicting objectives and support the management of commercially valuable invasive species. They illustrated their framework using the buffel grass invasion in Australia.

The framework comprises four components:

1. A state and transition model to represent the invasion dynamics of buffel grass and the effect of management actions.
2. Utility functions to represent the relative values of buffel grass cover in terms of production and biodiversity utilities (indicative of grazer's and conservationist's relative 'happiness' regarding buffel grass cover); expert and empirical data was used for the construction of the model and utility functions.
3. Management strategies that minimize losses in production and biodiversity utilities in the absence of budget constraints. They used stochastic dynamic programming and multi-criteria decision analysis which explicitly account for trade-offs between production and biodiversity conservation concerns.

4. A sensitivity analysis to assess the impact of assumptions of the model and utility functions.

Management complexity arises from biodiversity-production trade-off situations in which the desirable state of buffel grass cover and effective actions to achieve this state depend on the utility functions. Management solutions were particularly sensitive to the shape of the utility functions for biodiversity. Solutions were less sensitive to uncertainty surrounding the effectiveness of management actions.

The researchers found that in most biodiversity-production trade-off situations a compromise solution led to management for an intermediate level (>0–50%) of buffel grass cover. However, when maximal values for both biodiversity and production are high, it may be more practical to manage for one value rather than find a compromise solution where concessions from both sides are high.

The decision framework does not attempt to optimize economic outcomes but provides a guide for formulating trade-offs between opposing views, something that is relevant to the management of any natural resource management problem where there are conflicting objectives. 🍌

Reference

Grechi I, I Chadès, YM Buckley, MH Friedel, AC Grice, HP Possingham, RD van Klinken & TG Martin (2014). A decision framework for management of conflicting production and biodiversity goals for a commercially valuable invasive species. *Agricultural Systems* 125: 1-11.

The matrix reloaded

Complex ideas in ecology made simple

By Don Driscoll (Australian National University)

Last year I published a really exciting paper on the matrix in fragmented landscapes (Driscoll et al., 2013). The matrix is the land that patches of native vegetation are embedded in. More often than not it's cropland or grazing lands or plantation forests. My paper brought together a number of ideas about the matrix and outlines an overarching conceptual model of the conservation value of the matrix. And, if we're serious about conservation in production country, this type of understanding is critical to our capacity to saving biodiversity in these landscapes.

But here's the challenge. I think this is both an interesting and an exciting topic but I know that most people will never read this journal paper. How do I endeavour to spread the information and the value of this research? It's a challenge that confronts all EDG researchers when they publish their science. How do we get anyone beyond our small circle of fellow specialists to engage with our science?

Most of the time I don't have the capacity to do much beyond the research itself but this time I thought I'd try something different. This was a special paper, in my opinion; it deserved the extra effort. This time I decided to make a movie about the science in the article, about the matrix in fragmented landscapes! And (light bulb moment) my opening 'hook' would be a connection with the sci-fi thriller *The Matrix* (which has nothing to do with fragmented landscapes but does involve guns, computers and fights, and everyone has seen it).

So, I sat down and nipped out a simple script, dug out my camera then drew my characters in Texta and cut them out. I took over the family dining table for two weekends (and every evening between) of intense focussed activity (to the complete exclusion of everything else, except biological requirements), while I painstakingly filmed a short stop-frame animation video. It took heaps longer than I expected (my family weren't too happy about the loss of the dining table) and it's rough and ready edges are there for everyone to see. For all that, I'm quite proud of it (see the box 'The matrix in ecology').

Though it took time (all of my after work hours for several weeks) it was fun to do, it forced me to tell the story of my science in a simple, engaging and bare-bones fashion, and it made me put myself in the shoes of those outside of my scientific circle.

That was several months ago. I'm happy to report that my first foray into cinematography has had pleasing outcomes. My colleagues thought *The Matrix in Ecology* (the title of my three-and-half-minute epic) was excellent and that I didn't trivialise my science, so my reputation is still intact. Somewhere in the order of three thousand people have taken the time to view the video, most of whom I wouldn't mind betting would know little about the matrix in agricultural landscapes, so I think as an exercise in communicating to a broader audience it's been a big success. And, the positive feedback has led to me making another video on an up-and-coming paper (even bigger than the matrix, but I can't say anything more about this production at the moment, it's still hush hush).

But the impact could even be greater. Like a small snowball rolling down a hill, the idea of translating our conservation science into fun, engaging short videos is gathering size and momentum. The success of my matrix video led to the staging of the Great EDG Video Competition (run by me with several EDG colleagues) which came to a conclusion a couple of months ago.

“How do I endeavour to spread the information and the value of this journal article?”

The matrix in ecology

The video begins with two people dodging bullets in an opening in a forest...

The narrator (me) explains:

"In ecology, the matrix is not about people in long trench coats dodging bullets while plugged into a hyper-real computer program. When we talk about the matrix in ecology we are talking about the areas that surround patches of remnant vegetation.

"People tend to clear most of the native vegetation for livestock, crops or houses. Many native plants and animals can only live in the left-over patches of vegetation; it's their habitat, their home. The rest of the land is the matrix: the areas they can't live in.

"Our native species, surrounded by the matrix, face many problems. Plants and animals might die out of a patch due to disease or some other cause. If individuals from other patches can't move through the matrix to recolonise the patch where their neighbours died out, they will gradually vanish from the whole landscape."

And then it gets really interesting but you'll have to see it yourself to appreciate the REAL power of the matrix!

I'd also like to acknowledge Sam Banks and Annabel Smith for their contributions to the narration.

See *The Matrix in Ecology* at

<http://www.youtube.com/watch?v=JZwTZ-d1ZRE>



EDG researchers from around Australia put together six short videos (see the next page) and the results are fantastic. Three of them use stop-frame animation, while the other three use more traditional video techniques. All of them attempt to convey complex ecological ideas through simple stories, fun images and, in some cases, catchy music.

Well done contestants, you are a credit to our profession. What's more, your efforts this year will hopefully see this event flower and grow in the years to come.

I encourage everyone to take a few moments to see what they have achieved. I guarantee you'll learn something. I would also bet that viewing these efforts will leave you smiling. With luck they may also leave you infected with the bug of storytelling and video making, and who knows where that might lead. 🍌

More info: Don Driscoll don.driscoll@anu.edu.au

Reference

Driscoll DA, SC Banks, PS Barton, DB Lindemayer, & AL Smith (2013). Conceptual domain of the matrix in fragmented landscapes. *Trends in Ecology and Evolution* 10.1016/j.tree.2013.06.010. Download a pre-print: <https://dondriscoll.wordpress.com>

The Great EDG 2014 Video Competition

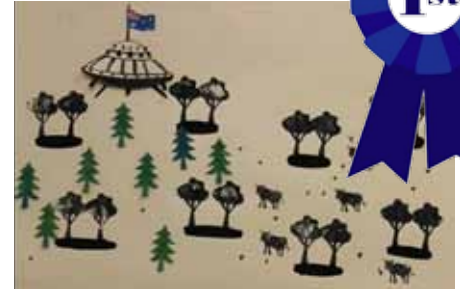
To see all six entries, please visit <http://www.edg.org.au/resources/edg-youtube.html>

Pine Fiction

A film by Alessio Mortelliti and Christina Thwaites (ANU)

On planet Earth there are 264 million hectares of forest plantation and the most common species are pines. What is the impact of pine plantations on biodiversity? Do pine plantations established on farm land increase or decrease the connectivity of bird populations. Based on data gathered by David Lindenmayers' research group for the 'Nanangroe project', this video promises to tell all!

More info: Alessio Mortelliti alessio.mortelliti@anu.edu.au

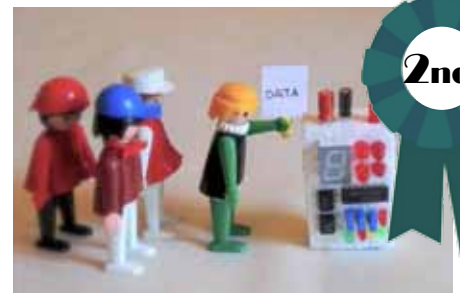


Now you see it, now you don't! Imperfect detection & SDMs

A film by Gurutzeta Guillera-Arroita & José J. Lahoz-Monfort (University of Melbourne)

Manager Phil shares a challenge while studying the habitat preferences of the rare blue-spotted wild horse. After reading recent research about the impact of species detectability in studies of species distributions, he realises imperfect detection was a relevant issue to consider in their analysis. Phil's story highlights the value of research that provides improved quantitative tools and practices to support more robust environmental decisions.

More info: Gurutzeta Guillera-Arroita gurutzeta.guillera@unimelb.edu.au



Rescuing the Reef

A film by Jutta Beher and Carissa Klein, University of Queensland

Impacts of climate change and poor water quality are the most significant threats to the Great Barrier Reef (GBR). Water quality can be improved at a local scale and could increase the resilience of the GBR to the impacts of climate change. As there are limited funding resources, it is essential that we prioritize where and how to best manage water quality. A transparent and economically sound investment prioritization process does exist.

More info: Jutta Beher j.beher@uq.edu.au



Conserving bats in cities

A film by Pia Lentini, University of Melbourne

What's the best way of growing a city to accommodate both humans and biodiversity? This video explores this question in relation to bats. Even if people aren't aware that bats are around, they typically make up a large component of native mammals in urban areas. In this video Pia shows how we're using data collected through community bat box programs to predict how populations of both urban tolerant and urban sensitive species will change as Melbourne grows.

More info: Pia Lentini pia.lentini@unimelb.edu.au



Burning the building blocks of life

A film by Annabel Smith, ANU

What happens to plants and animals when we burn the bush? And how does this impact their genes: the building blocks of life? How can we find balance between our needs and the needs of other species that call this planet home? Against a charred, blackened landscape, this film explores popular perception and science. It suggests a more balanced use of fire in the natural environment is required.

More info: Annabel Smith annabel.smith@anu.edu.au

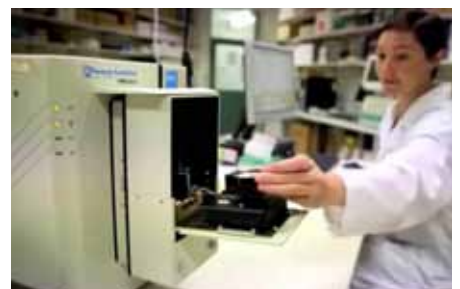


Plant-animal interactions across landscapes

A film by Christina Zdenek and Kara Youngentob

Plants have an arsenal of chemical defences that can poison animals and reduce the nutritional quality of forage. Concentrations of foliar nutrients and toxins vary among plants and across landscapes. Animals must make decisions about what and where to eat based on the quality and availability of food resources. A team of scientists are working to develop new methods to assess forage quality across landscapes.

More info: Kara Youngentob k.youngentob@uq.edu.au



Victoria's hawkweed eradication program

An enduring alpine partnership

By Cindy Hauser (NERP & University of Melbourne), Neil Smith (Department of Environment and Primary Industries) & Charlie Pascoe (Parks Victoria)

Three species of hawkweed – orange hawkweed (*Hieracium aurantiacum*), mouse-ear hawkweed (*H. pilosella*) and king devil hawkweed (*H. praealtum*) – have established small populations at the Falls Creek Alpine Resort and surrounding areas of Victoria's Alpine National Park. This is not good news. These places are of national significance due, in part, to their unique flora and fauna. The hawkweeds' invasive potential threatens the natural values of these areas. Hawkweeds' ability to spread rapidly and disrupt floristic communities is a major concern (see the box 'Invaders par excellence'). In New Zealand, these weeds have already dominated over 500,000 hectares of vegetation cover and here in Australia early modelling estimated the threat to agriculture at \$74 million.

The challenge of controlling an invasive species like hawkweed is enormous, requiring skills and analysis that lie across many groups. Here we set out a few of the roles that science has played in helping managers get on top of this situation. Bringing together that science has forged an enduring partnership that might serve as a model to future efforts aimed at controlling damaging invasive species.

A Project Control Group has been established to oversee eradication programs for all three naturalised species (see the box 'Project Control') in Victoria. The challenge is to find and kill individual hawkweeds over the 900 hectares that is currently at risk of infestation. The terrain is often steep and occasionally dangerous, and even when hawkweeds are found and treated, any root fragments left behind can regrow. Since 2003, the Project Control Group has collected high quality data and this has allowed researchers to focus on answering key questions for eradication.

Where are the hawkweeds?

Given the large risk area for hawkweed infestations, the first research priority was to identify where hawkweeds are most likely to occur within the landscape. Hawkweed managers had the unusual advantage of knowing with some confidence where the



A volunteer seeks hawkweed in the 2012 detection experiment. (Photo by Roger Cousens)

main source of seed spread was likely to be: a Falls Creek garden bed in the case of orange hawkweed, and a large and dense infestation adjacent to the Rocky Valley Dam in the case of king devil. Researchers used local wind data to predict where seeds were likely to have travelled with respect to the source populations, initially relying on a single distance observation and later expanding to sophisticated simulations of seed travel tailored to hawkweed seed characteristics and the alpine landscape. Researchers also investigated what habitats would be suitable for hawkweed germination and establishment, via expert opinion and glasshouse experiments. Overlaid with dispersal predictions, managers were now armed with maps to help target their search efforts.

How hard should we look?

So we know where to look. But how much effort should we put into finding individual plants? Hawkweed surveys are typically carried out in teams, with people walking in a line formation, scanning the



Receiving the University of Melbourne Staff Engagement Award (l-r): Roger Cousens, Nicholas Williams, Cindy Hauser, Neil Smith (DEPI) & Iris Curran (Parks Victoria).

Project Control

The program to eradicate invasive hawkweed species from Victoria's Alpine National Park has been a long and concerted effort with broad community support. Overseen by a Project Control Group, the program relies on the efforts of the Department of Environment and Primary Industries, Parks Victoria, Falls Creek Resort Management, Mt Buller and Mt Stirling Resort Management, Weed Spotters, weed control contractors, volunteers, and researchers to help find and control hawkweeds (Herbert et al 2013). University of Melbourne researchers have been involved since the very beginning, when orange hawkweed was first discovered by a University Field Botany class back in 1999. In the 15 years since, an ongoing research program has helped the Project Control Group target their search and control efforts across the national park, even earning the team a University of Melbourne Vice-Chancellor's Staff Engagement Excellence Award in 2013 and a Nancy Millis Science in Parks Award in 2014.

Herbert, Curran, Hauser, Hester, Kirkwood, Derrick & King. (2013) All eyes focussed on hawkweed eradication in the Victorian alps – a partnerships approach. pp 140-145 in Hanwen Wu (ed) *Proceedings of the 17th NSW Biennial Weeds Conference*. The Weed Society of NSW. September 2013, pp 140-145.

“The challenge of controlling an invasive species like hawkweed is enormous, requiring skills and analysis that lie across many groups.”

ground for the species. Not all ground provides the same search experience – steep slopes can slow searchers down, and hawkweeds will generally be easier to spot in grass than when the searchers are knee-deep in heath. Researchers developed a model to optimise resource allocation across a landscape, making use of the maps described above and this variable relationship between effort and detection. This research was previously discussed in [Decision Point #31](#). The research team have been supplying prioritisation maps based on this optimisation method to the Project Control Group annually since the 2011/12 summer search.

How ‘detectable’ are hawkweeds?

While orange hawkweeds have distinctive orange flowers, their non-flowering rosettes and the yellow-flowering king devil and mouse-ear hawkweeds can be mistaken for several other daisy species at first glance. Between identification challenges and the varied terrain of the park, there’s a risk that search teams might miss hawkweeds in spite of their efforts and experience.

To learn more about the detection rates of ground searches, researchers and agency staff collaborated on two ‘hide and seek’ field experiments. Researchers hid glasshouse-grown hawkweeds and flower mimics in amongst different vegetation types, then searchers – government agency staff, contractors and volunteers – were asked to find them.

Analysis of the data revealed enormous variation in the time-to-detect-hawkweeds depending on the circumstances. Flowering hawkweeds were often detected quickly but the presence of other yellow-flowered species did cause distraction, and non-flowering rosettes were more often missed than found, especially in dense vegetation types. The resulting detection models can be fed directly into the resource allocation optimisation, and are used by the Project Control Group to pre-emptively set and retrospectively understand the level of confidence they can have in the surveys they undertake.



A king devil hawkweed mimic. Why is it a mimic? See the story on page 16. (Photo by Roger Cousens)

Invaders par excellence

“Hawkweeds are incredibly successful invaders. These hardy perennials tolerate a huge range of conditions including snow and poor soils. They are very fecund, with summer thistle-down seeds borne far on winds, animals and vehicles and winter-tolerant stolons converting individual plants into dense mat-like colonies. And they indulge in underground chemical warfare, secreting chemicals that deter the roots of other plants. Their ecological devastation is horribly evident around the world. In New Zealand, mouse-ear hawkweed has completely displaced extensive areas of alpine tussock grasslands in the South Island.”

Source: Blog of the [Invasive Species Council](#), Linden Gillbank

The future of hawkweed eradication

Over the past three seasons the number of new plants found has remained low, despite increased and more strategically targeted surveillance efforts. An ‘eradograph’ confirms that surveys appear to be effectively limiting the orange hawkweed and king devil incursions, while known infestation sites are being controlled and their recurrence is declining.

As the list of known hawkweed sites has expanded throughout the program, the burden of regularly revisiting sites to ensure ongoing control is increasingly dominating the program’s budget. To address this challenge, researchers have recently developed statistical models predicting infestation recurrence, and are working on optimisations to effectively balance effort spent on revisiting these known sites against effort spent searching for not-yet-discovered infestations. In parallel, the Project Control Group has trialled new chemicals that are extremely effective in killing hawkweed in one application, thus reducing the need for revisits.

Now that detection experiments have established that human searchers struggle to find non-flowering hawkweeds in thickly vegetated terrain, the Project Control Group is investigating whether a dog can be trained to detect hawkweeds as part of the surveillance and monitoring program. With their known heightened senses of smell, agility and ability to be trained, it is possible that a hawkweed detection dog could more quickly and effectively find plants at all growth stages, potentially even sniffing out underground rhizomes than human searchers would ever find.

Ridding the alps of hawkweeds is still some years away, but looks to be on track. The Project Control Group has responded swiftly and responsibly to the incursions, investing their resources and harnessing community support to seek out and destroy hawkweeds across land tenures, and most recently, assessing the potential of detection dogs. Their commitment to quality data collection and support of relevant research has generated new findings that could not be achieved by researchers alone. These findings have been effectively incorporated back into eradication operations to ensure effective targeting of the Project Control Group’s resources.

These hawkweed invaders are up against a heck of a team! 🐾

More information: Cindy Hauser chauser@unimelb.edu.au

We gratefully acknowledge the financial support of Parks Victoria through their Research Partners Program, the Victorian Department of Environment and Primary Industries, the NSW Office of Environment and Heritage, the Australian Weeds Research Centre and the Australian Research Council (via Linkage Project 100100441).

You can access a list of this team’s publications at <http://cindyhauser.wordpress.com/2013/10/11/engagement-award-for-hawkweed-program/>

Biodiverse carbon plantings on Indigenous land

What's possible, what's optimal?

By Anna Renwick (University of Queensland)

The Carbon Farming Initiative (CFI) is a carbon offset scheme established by the Australian government. It provides opportunities for land owners and local communities to alter land management practices to reduce or sequester carbon emissions. In addition to storing carbon these practices also have the potential to deliver other environmental benefits such as the conservation of biodiversity and the provision of other ecosystem services. The CFI legislation also contains provisions to provide benefits to Indigenous communities, and many indigenous leaders have shown interest in engaging in carbon offset projects.

Various approved methodologies exist within the CFI to guide land managers on how they can sequester carbon in a way that will be acknowledged by the government. Tree planting is one such methodology and, if mixed native trees are planted, this has the potential to provide additional ecosystem services. Mixed plantings also have greater resilience to disturbances. Despite the interest of Indigenous communities in these schemes, determining the optimum locations for tree planting to ensure more 'bang for their buck' is unknown. We therefore conducted a spatial analysis of the carbon and biodiversity potential of planting biodiverse native vegetation on Indigenous land across Australia (Renwick et al. 2014).

Three maps

So what does such an analysis entail? Basically it involves comparing all the places on Indigenous land that are suitable for mixed tree plantations for their conservation value, carbon storage value and cost. To do this we compiled three maps which we could overlay on each other. The first was a map of the potentially plantable area

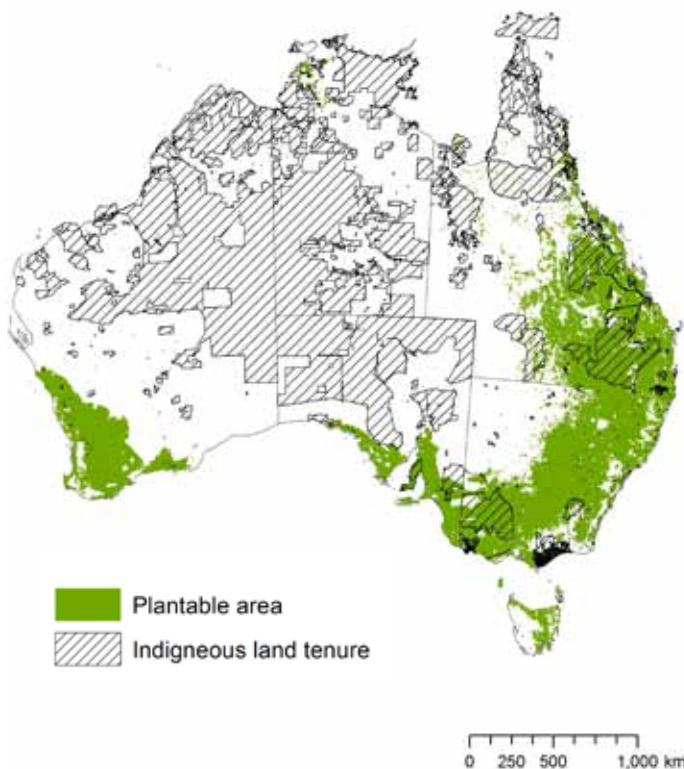


Figure 1: Map of Indigenous tenure overlaid on plantable areas for biodiversity. (From Renwick et al., 2014)

“Almost 19% of the combined high and very high priority areas for cost-effectively meeting biodiversity goals are on Indigenous lands.”

across Australia. This is the area that had historically (pre-1750) been covered by vegetation containing trees (that were at least 1.3m tall) but have since been cleared, excluding built up areas.

The second was a comprehensive map of Indigenous tenure across Australia. Indigenous land tenure data was sourced from the official agencies responsible for the registration of various Indigenous land tenures including the National Native Title Tribunal, Conservation and Protected Areas Database, Department of the Environment (formerly Department of Sustainability, Environment, Water, Populations and Communities), Indigenous Land Corporation, National Land and Water Resources Audit and Geoscience Australia. The classes of Indigenous land represent legally recognised tenure, and they vary in the type of rights and opportunities conveyed with the form of tenure.

The third was a map of carbon sequestration potential for mixed environmental plantings.

Conservation value

Vegetation type was used as a surrogate for biodiversity. The 63 major vegetation subgroups from the National Vegetation Information System (NVIS version 3.1) were intersected with the 85 Interim Biogeographic Regionalisation of Australia (IBRA) bioregions to generate 1886 unique vegetation types across Australia. Of these, 1185 vegetation types contained trees of at least 1.3m tall and thus qualified for carbon planting. A total of 139 of these vegetation types have been cleared to below 30% pre-1750 extent and considered a high priority for restoration. We therefore set a target to restore each vegetation type up to 30% of its pre-1750 extent as a biodiversity co-benefit to planting trees for carbon sequestration.

Using the conservation planning tool Marxan and an economic scenario reflecting the Australian government's 2011-2012 carbon trading price of AU\$23/tonne (establishment cost AU\$1000 per ha, no water cost, baseline growth rate, discount rate 5%, carbon selling price of \$20/tonne), Josie Carwardine and colleagues et al (unpublished data) determined the cost-effectiveness of areas across Australia for sequestering carbon and meeting the vegetation restoration targets of 30% of pre-1750 extent. From this, the relative priority of each 4km² block within the potentially plantable area for cost effectively meeting the combined carbon and biodiversity goal was determined.

We then overlaid the map of Indigenous land tenure with maps of carbon sequestration, biodiversity features and the relative priority areas to determine the proportion of carbon and biodiversity goals that can be met on Indigenous land.

The price of carbon

Approximately 92 million hectares of land in Australia has been cleared and has the potential to be replanted with native vegetation. This would sequester around 710 Mtonne CO₂/year over the next 40 years. The amount of this area that will be available for this activity, however, depends on the profitability for environmental planting. This, in turn, is dependent on the carbon price and other

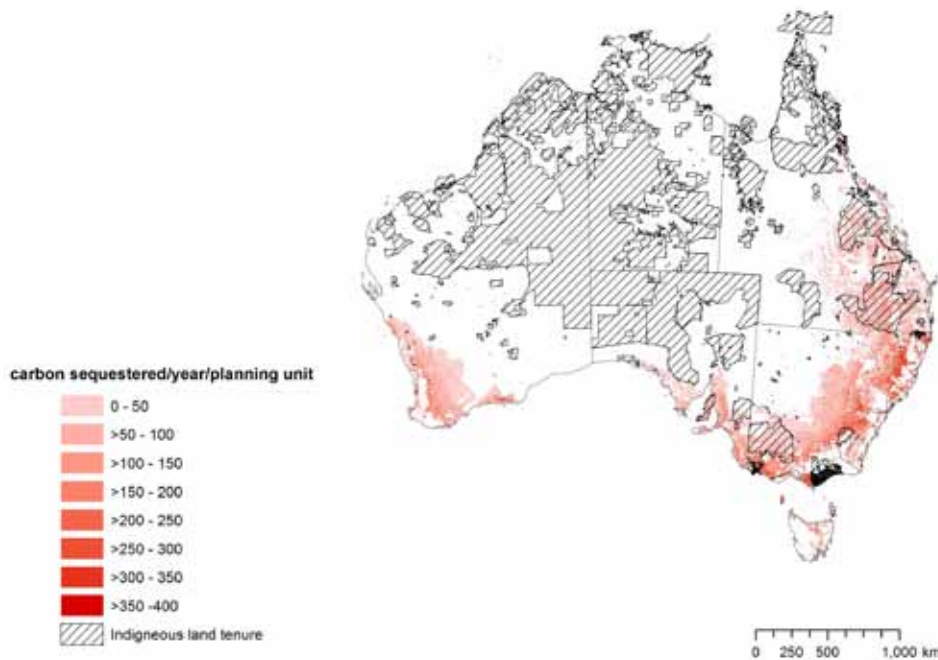


Figure 2: Map of Indigenous tenure overlaid on carbon sequestered (tonnes) per year per planning unit (4 km²) in plantable areas. (From Renwick et al., 2014)

economic considerations. For example, water cost and other social and practical constraints will influence the decisions made by land managers.

Using the 2011-2012 Australian carbon trading price of AU\$23/tonne, 31 million hectares of the area is profitable for carbon farming. This would sequester around 294Mt CO₂.

Almost a third of this area, 9.7 million hectares, is on Indigenous land which would sequester 83Mt CO₂ (28% of the total). If, however, the price of carbon drops to AU\$5/tonne, close to the price on international markets in 2013, the profitable area for carbon farming is reduced severely to only 5 million hectares and the potential for Indigenous communities to get involved would be greatly limited. (see figures 1 and 2)

Almost half of the plantable area contains 139 vegetation types that have been cleared to below 30% of pre-1750 extent. Almost one fifth of the plantable area on Indigenous land contains 79 vegetation types that have been cleared to below 30% of the pre-1750 extent. Two of the vegetation types can only be restored in a natural ecosystem on Indigenous land.

Potential priorities

Almost 19% of the combined high and very high priority areas for cost-effectively meeting biodiversity goals are on Indigenous lands primarily in southeast Queensland, eastern New South Wales, southwest Victoria, southeast South Australia and southwest Western Australia.

There are little carbon and biodiversity benefits from planting on Indigenous land in northern Australia. This reflects the low density of forests and historical clearing that has taken place in northern Australia. Other carbon offset schemes in this area may be more appropriate,

for example savanna burning.

Given that Indigenous land cover 19% of the total biodiversity plantable area, this result indicates that Indigenous lands are approximately as important as the rest of Australia for achieving this combined goal cost-effectively. (see figure 3)

The analysis discussed here represents a top-down approach to consider the challenge of biodiverse carbon plantations on Indigenous land. It provides one perspective of the potential for Indigenous communities to get involved in carbon projects.

The next stage is to test these model results in partnership with local Indigenous communities. It's likely that these communities may require additional information, special training and community engagement skills to work through the options.

Despite the positive potential for the CFI to contribute to biodiversity and provide benefits to Indigenous communities and broader society, the recent change in government in Australia highlights the instability of the policy and political environment surrounding the CFI initiative. This opens up new risks and uncertainties to carbon farming efforts, including those adopted by Indigenous communities.

More info: Anna Renwick a.renwick@uq.edu.au

Reference

Renwick AR, CJ Robinson, TG Martin, T May, P Polglase, HP Possingham & Josie Carwardine (2014). Biodiverse Planting for Carbon and Biodiversity on Indigenous Land. *PLOS One*. DOI: 10.1371/journal.pone.0091281 <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0091281>

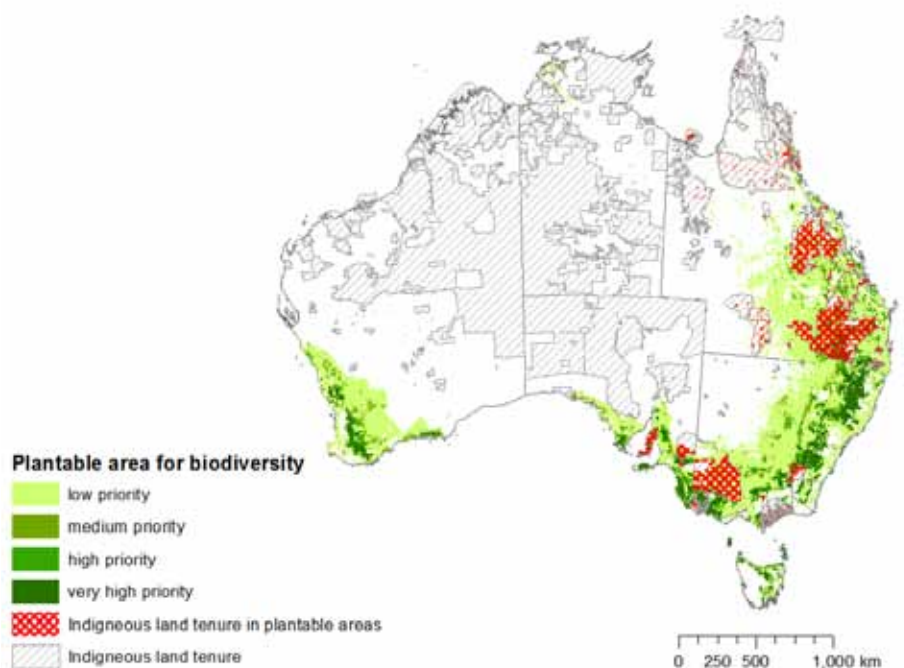


Figure 3: Relative priority (selection frequency) of areas for meeting biodiversity and carbon goals for environmental planting overlaid with Indigenous tenure. (From Renwick et al., 2014)

Socially-acceptable conservation planning

How can we integrate biological and social values to improve conservation?

By Rachael Vorwerk, Amy L. Whitehead and Heini Kujala (University of Melbourne)

Understanding how society perceives and values different areas of the landscape is important for effective land-use planning. Indeed, making use of social values is arguably one of the most important challenges in modern conservation planning, yet their potential remains poorly exploited. Previous research suggests the inclusion of social values can reduce conflicts between stakeholders and enable a more efficient implementation of conservation actions. However, the potential trade-offs related to incorporating social values into spatial conservation planning are not well understood. These gaps in knowledge led Amy Whitehead and colleagues to investigate methods for integrating social values into spatial conservation planning.

Obtaining social and biological values

The research group collected spatial data on social values by conducting a Public Participation GIS (PPGIS) survey in the Lower Hunter Valley in eastern New South Wales. Local residents were asked to map areas perceived to be important for their natural or potential development values. Randomly-selected landowners were given a map of the region and a set of sticker dots that corresponded to different social values, including biodiversity, natural significance and intrinsic value types (social values for biodiversity). Another set of stickers corresponded to areas believed to be appropriate for different types of future development (social values for development). Participants were asked to place stickers on areas of the map they associated with each of the social values for biodiversity and development. The responses were then digitised and used to create density maps for each social value in the region.

In addition to this data on social values, the researchers used

“Participants were asked to place stickers on areas of the map they associated with each of the social values for biodiversity and development. The responses were then digitised and used to create density maps for each social value in the region.”

biological data to represent areas important for conservation. Seven fauna species considered to be vulnerable to land clearance were selected to represent the biological values in the Lower Hunter Valley. These species were mapped onto the landscape using species distribution models, derived from occurrence data.

Integrating social and biological values in conservation planning

The spatial prioritisation of the Lower Hunter Valley was done using the popular conservation planning software Zonation (see <http://cbig.it.helsinki.fi/software/zonation/>). The program ranks sites in the landscape based on their importance for all features in the model, producing a spatially-explicit output that identifies areas of high value. Zonation is typically used with biological data to identify areas of high conservation value but any spatially-explicit variable of interest, such as social values, can be included.

The researchers first examined three scenarios that identified priority areas for each of the datasets. The top 30% of each individual prioritisation was overlaid on the other prioritisations to identify potential areas of synergy or conflict. Identifying these areas spatially allows decision makers to target specific actions and policies depending on biological and social values (Figure 1). For example, an area with high biodiversity values and high community awareness for its natural significance (2) may require a different strategy to one with conflicts between high biodiversity values and a perceived suitability for future development (6).

The next step was to integrate the three datasets into spatial prioritisations to examine whether the inclusion of social values for biodiversity and development would come at the cost of trading off actual biological values.

The researchers investigated six integrated prioritisation scenarios that explored different methods

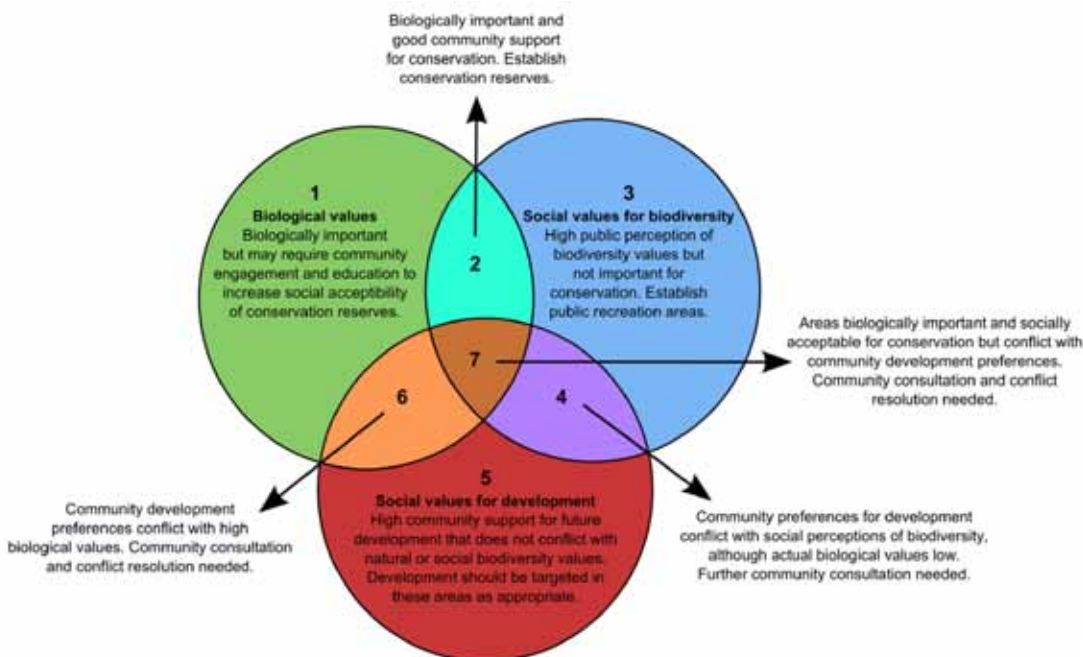


Figure 1: Overlaying the priority areas from biological values and social values for biodiversity and development allows decision makers to identify potential areas of synergy or conflict between the different value sets. Each combination requires a specific type of management action and may require further community engagement or specific policy implementation to ensure socially-acceptable conservation outcomes.

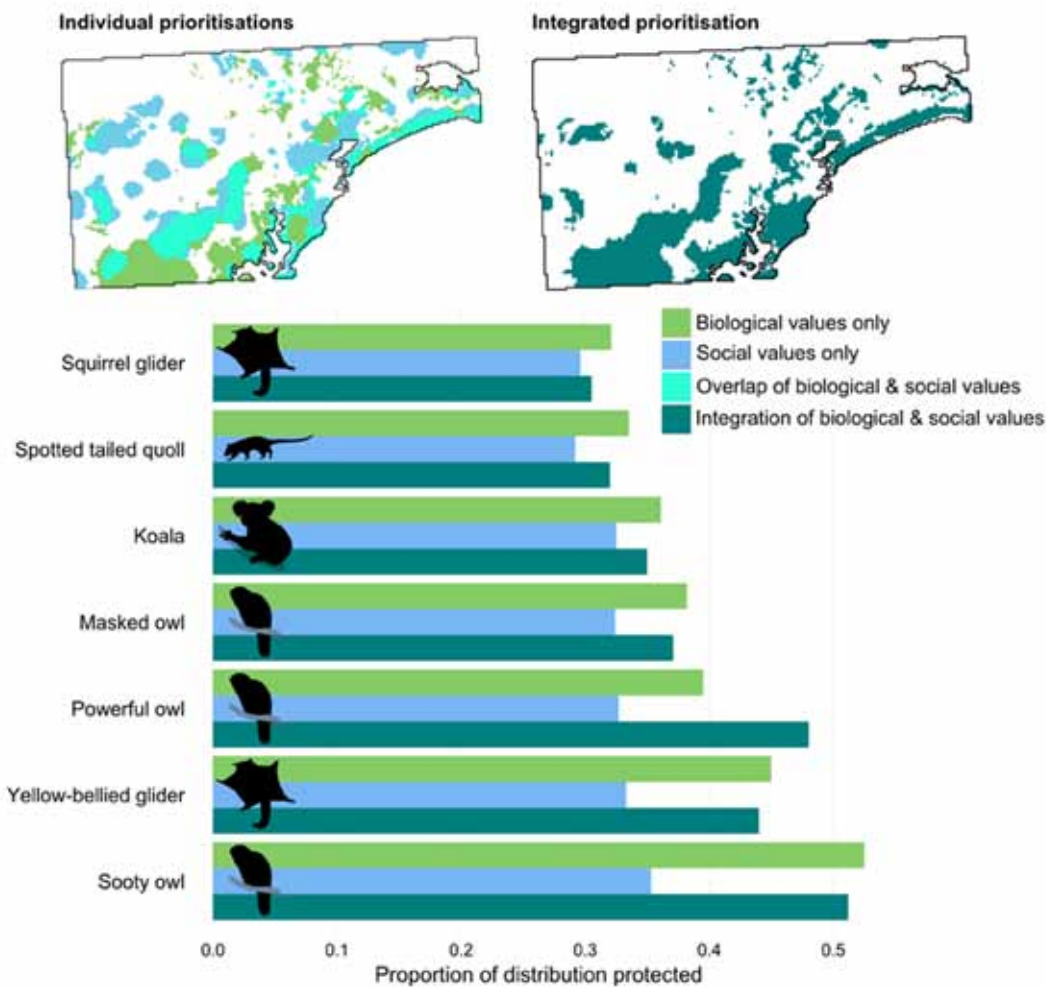


Figure 2: Researchers evaluated the effectiveness of different spatial prioritisation scenarios by isolating the top 30% of each value (biological or social). Six of the seven species' distributions in the Lower Hunter Valley, NSW, were best represented when the prioritisation only included biological values, while all species were less protected when prioritising social values for biodiversity alone. In contrast, the prioritisation of both biological and social values identified areas for conservation that were socially acceptable and did not lead to significant tradeoffs in conservation value.

of integration. Social values for biodiversity were either included as features in the prioritisation together with the biological data, or as a cost layer where the priority areas were pushed towards those areas that the community perceived as having high biodiversity value. Social values for development were either included as a cost layer where the solution was guided away from areas considered to be important for future development, or as a mask where the top 30% of the high priority areas for development were forced out of the conservation solution.

Identifying socially-acceptable conservation areas

Not surprisingly, the best option for conserving of the seven threatened species included in the model was the distributions obtained when the prioritisation only considered biological data (Figure 2). Interestingly, however, a similar proportion of each species' current distribution was captured when biological and social values for biodiversity were integrated and prioritised together, although the spatial location of some conservation areas changed. Even when the areas perceived to be most important for development were forced out and the remaining sites were prioritised for both biological and social values for biodiversity, Zonation still managed to find a solution that gave reasonable protection to the seven fauna species.

“This is good news for planners as it demonstrates spatial flexibility in the way conservation targets may be met in the Lower Hunter Valley.”

This is good news for planners as it demonstrates spatial flexibility in the way conservation targets may be met in the Lower Hunter Valley. However, it is important to note that some of this flexibility might stem from the type and number of species used in the study; all

seven species are forest dwellers and people often perceive forests as more valuable natural areas than, for example, grasslands. The integration of biological and social values may result in greater tradeoffs if a more diverse set of habitats or species were included.

This is one of the first studies to fully integrate spatially-explicit biological and social values into a quantitative spatial prioritisation analysis, providing a simple method to achieve both socially-acceptable and scientifically-defensible conservation outcomes. Such an approach can help decision makers target communication strategies and management actions to specific areas of the landscape, while integrated prioritisations can identify balanced conservation solutions that protect biodiversity and incorporate societal values. Although this approach may create an extra level of complexity for conservation planners, it offers the potential to improve conservation outcomes in contested landscapes.

More info: Amy Whitehead amy.whitehead@unimelb.edu.au

Reference

Whitehead AL, H Kujala, C Ives, A Gordon, PE Lentini, BA Wintle, E Nicholson & CM Raymond (2014). Integrating biological and social values when prioritizing for biodiversity conservation. *Conservation Biology*. doi: 10.1111/cobi.12257

The development of the EPBC Act offsets assessment guide

And the many benefits of bridging the science-policy divide

By Martine Maron (University of Queensland) and Phil Gibbons (ANU)

I spy an outcome

To highlight the many contributions our research is making towards conservation outcomes, *Decision Point* is running a series of short stories on what we have achieved. In this instalment Martine Maron and Phil Gibbons talk about the creation of the offsets assessment guide for the Department of the Environment and the additional co-benefits that have been generated through the collaboration.

Environmental offsetting involves compensating for environmental damage at one location by generating ecologically equivalent gains at another. The aim is that there is 'no net loss'. Offsets are increasingly being used as a regulatory tool to balance sustainable development and environmental conservation. Unfortunately, such schemes are often prone to failure due to poor design and implementation.

When the Department of the Environment introduced the new EPBC Act environmental offsets policy, collaboration with the NERP Environmental Decisions Hub was key to avoiding these pitfalls. The Department was faced with an enormous challenge – designing a transparent, simple-to-use, yet rigorous approach to decision-making around offsets. The approach had to give effect to the principles of the policy, while being flexible enough to support decisions about offsetting impacts on threatened species and ecological communities, and many types of possible impacts.

The Department of the Environment approached the NERP ED Hub to help advise on the development of a tool to give effect to the principles outlined in the new policy and take into account feedback from broader consultation. NERP researchers were able to draw from ten years of research in this area and the existing collaborative relationship with the Department of the Environment to develop this tool.

The offsets assessment guide is a major innovation in environmental impact assessment under the EPBC Act. It allows a judgement to be made on whether an offset meets the 'improve or maintain' test for impacts on nationally threatened species and ecological communities (see the box below). It is the first tool in operation in any jurisdiction worldwide that explicitly and transparently accounts for additionality, uncertainty, and time lags in calculating an offset requirement.

However, it should be noted that the outcomes of this collaboration reach well beyond the offsets assessment guide. They include:

- the involvement of a NERP PhD student, Megan Evans (who collaborated on the development of the Assessment Guide)

The first step

The first step in any offset scheme design is to define the objective. The EPBC Act environmental offsets policy aims to ensure that offsets 'improve or maintain' the viability of the protected matter that is impacted. The policy also requires that offsets target the particular threatened species or community that is affected: so a loss of black-throated finch habitat cannot be traded for a gain in cassowary habitat, for example.



Pictured above (from the left) are Phil Gibbons (EDG), James Tresize (Department of the Environment) and Michael Mulvaney (ACT Government). The trio are leading a field class of third year biodiversity conservation students on how to use the offsets assessments guide – a hands-on session of how you might calculate an offset for a proposed development of habitat for the threatened striped legless lizard.

working as a placement in the Department of the Environment to continue to develop offsets evaluation frameworks and processes.

- A collaborative paper led jointly by Department of the Environment staff & NERP researchers entitled: 'Bridging the Science-Policy Divide through Collaboration: The Development of the Australian Environmental Offsets Policy' (currently in review at *Environmental Conservation*).
- Department of the Environment staff involvement in undergraduate teaching on the topic of offsets assessment (at the ANU in a course on biodiversity conservation).
- International attention on the approach being developed in Australia; especially in terms of European policy development.
- IUCN benefiting from the experience through the membership of NERP researcher Phil Gibbons on their offsets technical working group.

The success of this project highlights the value of the relationships that the NERP program has fostered over time between academia and government. Reflecting on the development of the offsets assessment guide, the Director of the Department's Sustainability Research and Science Policy Section, Dave Johnson, summed it up like this: "Having dedicated people that see the strategic issues and are prepared to engage in an ongoing dialogue over the long term – that's not just a nice thing to have – it's the clincher for genuine collaboration and standout success."

More info: Martine Maron m.maron@uq.edu.au

“It is the first tool in operation in any jurisdiction worldwide that explicitly and transparently accounts for additionality, uncertainty, and time lags in calculating an offset requirement.”

Adaptive management for species reintroductions

A CEED NERP workshop
(University of Melbourne, April 2014)

By Stefano Canessa, Gurutzeta Guillera-Arroita, José Lahoz-Monfort and Darren Southwell (University of Melbourne) and Sarah Converse (USGS)

Reintroductions are active conservation strategies that involve intensive population management. Unfortunately, decisions about such management are often made in the face of great uncertainty. For example, what is driving the decline of the species being introduced? How will it behave once we reintroduce it to a new site? Our knowledge of the system we are managing is never perfect and therefore we are not sure how our target species will respond to our intervention (What should we feed animals in captivity? How many animals will survive after release?).

While there is much we don't know, the process of management itself provides practitioners with opportunities to learn thus informing the next round of decisions. This is what decision analysts call 'adaptive management'. Although this concept is increasingly advocated, reviews suggest that some confusion still exists around its precise meaning, and that much of the potential of adaptive management for conservation has not been fully realised. Furthermore, a gap still exists between the technical advances in adaptive management and the widespread implementation of this general approach to real-life problems.

With this in mind, decision analysts from different nodes of the EDG joined forces with the Reintroduction Group and the Conservation Breeding Specialist Group of the IUCN (RSG and CBSG) to run a workshop in April at the University of Melbourne on adaptive management and species reintroductions. The aim was to explore the potential for adaptive management within our disciplines while also describing the factors that could hamper its adoption.

To achieve this, we first clarified the importance of considering adaptive management as part of the broader structured decision making framework: What is the decision to be made? What are the key objectives of the reintroduction programme? What are the available management actions? How are they affected by uncertainty? If we could choose, which uncertainty should we try to resolve, and could we do so? The vital importance of this 'set-up' phase cannot be overestimated, as most management decisions are likely to gain enormous benefits from clearly structuring the problem.

After the problem is structured and clearly identified as a candidate for an adaptive management approach, we next identify a good management strategy (there are tools available to help make this selection). Managers often wonder where to start, and feel overwhelmed by the complexity of the most computationally-intensive approaches. There's a whole range of tools available for the treatment of uncertainty in decision-making (from value of information analysis to simulations and optimisation). Sometimes, applying simpler tools can still provide benefit to management programs. In general, every adaptive management problem will need to be approached taking into account its complexities as well as the skills and resources available.

In our workshop we followed three case studies relating to the

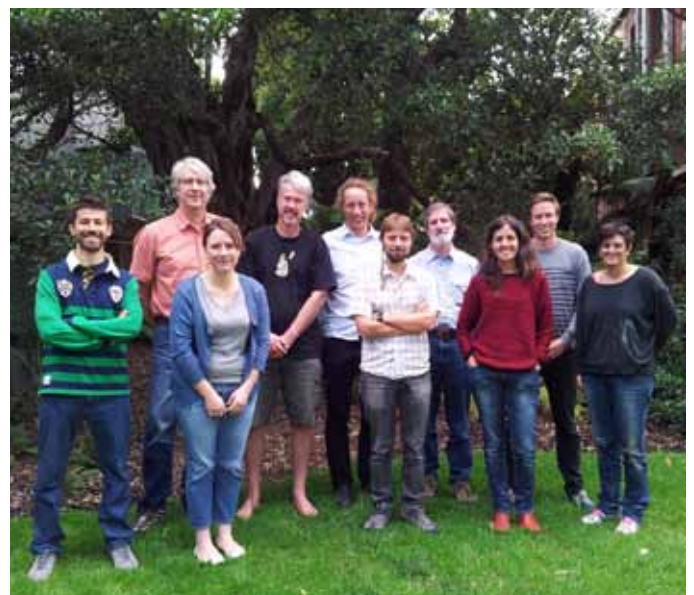
“Sometimes, applying simpler tools can still provide benefit to management programs.”

reintroduction of turtles in Europe, birds in America and frogs in Australia. We focused on how concepts and technical solutions could be communicated to reintroduction and captive breeding practitioners. We paid particular attention to how structured decision making and adaptive management could be incorporated in the support tools provided by the RSG and CBSG. For example, the analytical tools that the CBSG has developed (such as the program Vortex for population viability analysis, or Outbreak for simulations of disease transmission) can be linked to a more explicit decision framework, that helps evaluate actions and structure monitoring for adaptive purposes. These can be integrated in the workshop-based processes for conservation planning run by the CBSG.

Over the coming months, we will produce a set of guidelines with step-by-step examples, to explain where to start and how to implement adaptive management in reintroductions and ex-situ programs. We think answering these two key questions has the greatest potential in bridging the proverbial gap between theory and practice of adaptive management.

Continuous collaboration between CEED/NERP researchers and CBSG/RSG members will ensure the success of the work we have initiated in this workshop. It might also give us a second chance to see the Australian Rules football match we missed at the end of our workshop! 🍷

More info: Stefano Canessa canessas@unimelb.edu.au



Participants at the 'Adaptive management for reintroductions' workshop (from left to right): Stefano Canessa (UoM), Phil Miller (CBSG), Sarah Converse (USGS), Doug Armstrong (RSG), Michael McCarthy (UoM), José Lahoz-Monfort (UoM), Bob Lacy (CBSG), Gurutzeta Guillera-Arroita (UoM), Darren Southwell (UoM), Iadine Chadès (CSIRO).

Making decision for real

For several case studies of how structured decision making can be used to help conservation managers frame their problems, see [Decision Point #74](#). This issue also carries stories on adaptive management and the role of models in conservation decision making.

Tools for natural resource management and monitoring

A NERP Workshop

(University of Queensland, March 2014)

By Morena Mills and Nancy Auerbach (University of Queensland)

Good environmental decision-making requires rigorous scientific research. Yet, from the perspective of a researcher working in a University environment, applied research isn't necessarily an easy thing to do. Among other things, it involves unremunerated engagement with numerous stakeholders, politics, and complexity that can be difficult to translate into clear research questions. From the perspective of end users, applying research can also be very tricky: the relevance of research outcomes become fuzzy as local context is considered. On top of this, both groups have time constraints based on strict funding cycles. Researchers need to publish their findings in scientific journals, apply for grants and teach, while managers need to be able to make quick decisions as opportunities for on-ground action arise. Managers usually don't have time to wait until the research results are bullet proof, or to leisurely browse the scientific literature for potentially pertinent solutions to their problems.

To help bridge the gap between researchers and end users we ran a NERP-funded workshop that brought together NERP researchers, regional natural resource managers, and local and commonwealth government personnel. The workshop aimed to develop exciting and novel research questions that address current natural resource management challenges and that can be tackled collaboratively. In doing so it's hoped the outcomes of this research can be directly applied.

Our workshop ran over two action-packed days. The first day involved an exchange of ideas. A series of snappy five-minute presentations provided broad overviews of issues currently being tackled by researchers and managers. Levels of interest in the topics presented were good-humouredly gauged by workshop

Seven ideas for capacity building

1. **Database of planning tools** which help end users to decide what to use when
2. **Future forums** for managers and researchers to discuss resource management problems and solutions
3. **Short diplomas on NRM science** for managers
4. **Workshops on applying decision support tools** to particular issues
5. **Reviews on particular conservation actions** and issues
6. **Citizen science programs**
7. **Research directories which give managers easy access to scientists**

participants using our facilitator Terry Walshe's indicator-scale, with choices ranging between 'complete tosh' to 'deeply interesting and relevant'. We discussed key challenges and opportunities in small working groups associated with the most important topics considered. Topics included: prioritizing actions for water quality improvement, prioritizing actions for conservation, offsets, monitoring, strategic assessment, management under climate change, and planning to facilitate implementation of management. Key research questions were identified (see the box) and eight great ideas for capacity building were expounded (see the other box)

During the second day, managers received training in two decision frameworks that our research network is associated with. The two frameworks were Marxan.net (an online spatial prioritization tool) or INFFER (a tool for developing and prioritizing environmental projects).

The feedback received from both managers and researchers was that this was an engaging and rewarding workshop to be part of. We hope that this workshop served as a platform to develop new collaborations between end-users and researchers, making our research increasingly relevant. 🍷

More info: Morena Mills morena.mills@uq.edu.au and Nancy Auerbach n.auerbach@uq.edu.au

Key research questions

1. **What to do, when and where?** Identifying the most cost-effective conservation action to address a particular NRM issue
2. **How much money should be allocated to monitoring** the state of the environment versus undertaking conservation actions?
3. **How much confidence do we have with monitoring tools** and how much do we need before we change management?
4. **How do we manage enterprise transition under climate change?**
5. **Is it worth investing in ecosystems that are going to disappear** or change to novel ecosystems?
6. **How do we assess project success?**
7. **What do stakeholders (and NRM managers) need to know to get them to engage** in particular conservation actions?
8. **How will sea level rise impact indigenous resources?**
9. **Can we detect tipping points for ecosystem change** and use them to inform early warning systems for local government?
10. **What is the value of additional scientific information** for different types of decision-making?



During the workshop NRM managers were given the opportunity to receive training in how to use INFFER (Investment Framework for Environmental Resources) from David Pannell and Geoff Park.

Marine conservation planning in a changing world

An ARC Laureate Fellowship Workshop (Stradbroke Island, February 2014)

Researchers from EDG took the chance to tackle some of the fundamental questions relating to marine conservation planning in a workshop surrounded by the sea – on North Stradbroke Island. The workshop, the first in a series to be funded by Hugh Possingham's recent Laureate Fellowship, started work on some of the broad questions posed in that ARC grant. After three days and many potential projects, substantial progress had emerged on three papers:

1. Restore or protect marine habitats on land or in the sea?

Leader: Megan Saunders

Coastal marine ecosystems are influenced by threats occurring both in the sea and on land. Is it most cost effective to invest in mitigating threats on land or in the ocean? This project will examine scenarios where either restoration of degraded habitats, or protection of intact habitats, in the marine or terrestrial realm, are possible.

2. Manage or expand: exploring the trade-offs.

Leader: Nils Krueck

Marine protected areas facilitate biodiversity conservation and sustainable fisheries. However, their efficiency compared to traditional fisheries management regulations (eg, catch limits) is a common matter of debate. In this project, we balance investments in marine reserves vs fishing effort reduction, considering a range of conceivable management scenarios, conservation objectives and ecological feedback mechanisms.

3. Sea spare or sea share?

Leader: Jennifer McGowan

In order to maintain the primary benefits humans derive from the sea, namely food supply and the biological diversity that generates other ecosystem services, the ocean is divided into three general management regimes: open-access areas with no restrictions, managed areas that minimize damage to habitats, and no-take areas that prohibit all extractive uses. Yet, finding optimum management regimes is not straightforward and political drivers often underpin management actions. Using a theoretical example of a fish stock that depends on habitat type, we explore the conditions under which it is better to spare the sea, by investing more in no take marine reserves, or to share the sea, by investing in fisheries management to maintain habitat quality.



Pondering the big questions (surrounding marine conservation planning).

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. Here are six bytes from recent issues. If you would like to receive the *Dbytes* eNewsletter, email David.Salt@anu.edu.au

1. Priorities in the Pilbara

This report assesses the cost-effectiveness of 17 feasible strategies for managing threats to the 53 most threatened Pilbara species. Key outcomes are that management likely to provide all species with a >50% chance of persistence costs less than \$5 million/year. Amongst the most cost-effective strategies are managing introduced species and fire regimes.

<http://www.csiro.au/Outcomes/Environment/Biodiversity/Pilbara-threat-management-report.aspx>

And an associated article in *The Conversation* is here:

<https://theconversation.com/pilbara-shows-how-to-save-the-most-species-per-dollar-26971>

2. The cost of environmental degradation

The value of the global environment to human well-being, health and livelihoods fell by around US\$20 trillion (A\$21.5 trillion) a year between 1997 and 2011 due to loss of wetlands, coral reefs and tropical forests.

Reference: Robert Costanza et al (2014).

Changes in the global value of ecosystem services.

Global Environmental Change. 26: 152-158.

<http://dx.doi.org/10.1016/j.gloenvcha.2014.04.002>

3. Student review of IPCC Report

This 'experiment' used 90 PhD students across the world to review the IPCC Report before it was made public, to see if they could critically review the Report and find any errors or phrasing that need clarity. The review produced 3155 comments of which 1407 comments were incorporated into the government review.

Reference: Lianne van der Veer, H Visser & Arthur Petersen & P Janssen (2014). Innovating the IPCC review process—the potential of young talent. *Climatic Change*. DOI 10.1007/s10584-014-1145-9

4. Future Farming in Australia

Eighty percent of Australian farms produce only twenty percent of our food and nearly three quarters of farms don't earn enough income to sustain them. Australia is well placed to be a 'food bowl' to the hungry Asia Pacific region. But it's a highly competitive agricultural market place and climate variability will make things harder for those on the land. A Radio National discussion.

<http://www.abc.net.au/radionational/programs/bigideas/future-farming-in-australia/5444270>

5. Mitigation of Climate Change

IPCC Working Group III Contribution to AR5: Concluding four years of intense scientific collaboration by hundreds of authors from around the world, this report responds to the request of the world's governments for a comprehensive, objective and policy neutral assessment of the current scientific knowledge on mitigation.

<http://www.mitigation2014.org/>

6. Alpine grazing: does it reduce blazing?

ESA hot topics summary of the topic.

<https://www.ecolsoc.org.au/hot-topics/alpine-grazing-does-it-reduce-blazing>

Weird scenes inside the meadow

The story on hawkweed eradication (page 6,7) contains a picture labelled 'a king devil hawkweed mimic'? What on Earth is a hawkweed mimic and why bother making one? Well, as you will have figured out if you've read the story, these hawkweed invaders are nasty things to deal with once they've escaped: small, inconspicuous, fecund plants with thistle-down seeds easily transported by the wind. The only hope of eradication is removing them from the landscape before they've spread too far but detecting them in the alpine region in which they've established is no easy task. Effective search and detection is the key to successful eradication but how much effort needs to be expended is central to the planning of such an exercise. Cindy Hauser and colleagues designed a detection experiment to determine exactly what would be needed and an important part of that experiment was running trials of volunteers searching for hawkweed out in the field. Of



course, the researchers couldn't 'plant' real hawkweeds out in the field so instead they commissioned fifty mimics, artificial simulcra made from plastic and paint. These could 'safely' be deployed out in the alpine meadows ready for an eagle eye to spy.

Reference

Hauser, Moore, Giljohann, Garrard & McCarthy (2012). Designing a detection experiment: tricks and trade-offs. In Eldershaw V. (ed) *Proceedings of the 18th Australasian Weeds Conference*. Weed Society of Victoria, pp. 267-272.
<http://www.caws.org.au/awc/2012/awc201212671.pdf>

What's the point?

An uncertain climate at home

Homebuyers are being warned that extreme weather risk combined with climate events could double the price of a home insurance premium and erode property values in some areas by 20% or more within the term of a mortgage, according to new research commissioned by The Climate Institute in partnership with consumer group CHOICE.

In many parts of the country, climate change is mixing with natural variability to pile on the risk of damage to Australian homes. Where Australians live, the design of settlements, the cost of housing, and whether homes are insurable or not are not issues of the future, but very much issues of today.

"This report warns homebuyers that they need to consider extreme weather risk and climate change very seriously. In high-risk locations, some home insurance policies are already unaffordable and there are insurers who won't even offer policies at all," said John Connor, CEO of The Climate Institute.

Buyer Beware: Home Insurance, Extreme Weather and Climate Change was prepared by independent analysts Climate Risk. It was done by surveying insurance policy prices and availability around Australia and applying current climate change projections to forecast future policy costs.

<http://climateinstitute.org.au/buyer-beware.html>



ENVIRONMENTAL DECISIONS GROUP

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

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

Decision Point is the monthly magazine of the EDG.

The funding of the research presented in this issue of *Decision Point*, like most research, comes from multiple sources and is identified in the original papers on which the stories are based (references are provided in each story). In terms of CEED and NERP ED, the research on biodiverse carbon plantings (p8,9) was supported by NERP and CEED; and the work on integrating biological and social values in conservation planning (p10,11) was supported by NERP.

To contact the EDG please visit our websites at:

<http://ceed.edu.au/> or <http://www.nerpdecisions.edu.au/>

