



Edition (5)
July 2010

Terrestrial Research E-bulletin

Convener's Update

Welcome to the July edition of the TRE-Bulletin. The last three months have been extremely productive in the Terrestrial Biodiversity Network, culminating in the recent NCCARF Conference on the Gold Coast.

The 1st International Climate Change Adaptation Conference –Climate Adaptation Futures was held by NCCARF on the Gold Coast in June. This conference was a highly successful event, cutting across sectors, with about 900 national and international participants.

This three day event hosted talks and discussions in all areas including Terrestrial Biodiversity and Ecosystems. However, some general themes were apparent by the end of the conference and summarised in the last plenary session.

The strongest sentiment was that Adaptation alone would not be enough to overcome the impacts of climate change and that mitigation was essential to the successful minimization of impacts. It was stated that adaptation and mitigation were both complementary and essential if we are to achieve successful adaptation outcomes.

The other take home message was that adaptation science needs to be multi-disciplinary with firm links developed across sectors and networks if we are to minimize the impacts of climate change. The Terrestrial Biodiversity network is actively linking up with other networks to start this process by holding integrating workshops. The first cross cutting workshops will be held next year and tackle themes such as adaptation needs in riparian ecosystems (freshwater and terrestrial networks) and estuarine systems (marine, freshwater, terrestrial and settlements/ infrastructure networks).



The diverse multi-disciplinary nature of this conference was an obvious success and has kicked-off many cross sector collaborations that will help us advance adaptation science for the future.

This issue, we help celebrate International Year of Biodiversity with a special article on the importance of biodiversity in Australia, and the potential impacts of climate change on our terrestrial biodiversity.

Also, in addition to our usual 'Must Read' and 'Conference Update' sections, we have a summary of the recent NCCARF Genetic Translocation Workshop, held in Melbourne, and an article on the potential impact of climate change on amphibian malformations in North America.

We hope you enjoy this issue and we will be back again in October with more adaptation news.

Steve Williams & Lesley Hughes

Meet the Steering Committee

Professor Barry Brook

Barry is the co-director of the Global Ecology Group, and Foundation Sir Hubert Wilkins Chair of Climate Change, at the University of Adelaide.



Barry and his research group use statistical and modelling techniques to investigate the impacts of global change on biodiversity. They are also working to develop new modelling systems to predict impacts and adaptation responses in order to better inform management decisions.

Barry has published numerous scientific and popular articles, and has received a number of awards recognising the importance of his research.

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2010: Year of Biodiversity

International Year of Biodiversity (IYB) is a year long celebration of biodiversity and its importance and value for life on Earth. Initiated by the United Nations, it is hoped that IYB will raise awareness of the importance of biodiversity through activities and events, and will also influence decision and policy makers to elevate biodiversity closer to the top of the political agenda. Two of the main goals of IYB are to enhance public awareness of the threats to biodiversity, and to promote innovative solutions to reduce these threats. To celebrate and raise awareness of IYB, in this issue we focus on the importance of biodiversity to our well-being, and the ability of adaptation management to mitigate some of the major threats to biodiversity as a result of climate change.

The Importance of Biodiversity

Biodiversity is the variety of life on Earth; the combinations of life forms within ecosystems, their interaction with one another and with the physical environment.

The recent Millennium Ecosystem Assessment (MA) confirms that biodiversity makes a crucial contribution to human life. Ecosystem services range from the provision of fresh air and water, to fisheries production, pollination services, treatment and cures for disease, and access to places of spiritual value.

But, the MA also concludes that human actions are destroying the natural environment and its associated capital. Despite our intrinsic moral obligation to protect the environment, as well as the importance of biodiversity to our economic, cultural and spiritual well-being, species, genes and habitats are being lost at an unprecedented rate.



The Unique Australian Biota

Australia is one of the most biodiverse countries on Earth, and supports around 10% of global biodiversity. Australia's biodiversity makes a significant contribution to the economy, through sectors such as tourism, fisheries and forestry, and is also essential to our identity and culture. A very high proportion of Australian species are endemic and found nowhere else including 85% of our terrestrial mammals, 89% of our reptiles, 93% of our frogs, and 91% of our flowering plants. But Australia has suffered the largest documented decline in biodiversity of any continent over the past 200 years. The main threats to terrestrial biodiversity include habitat loss, invasive species, inappropriate fire regimes and climate change.

Climate Change and Biodiversity

In terms of the impact of climate change, the Intergovernmental Panel on Climate Change have identified natural ecosystems as one of the most vulnerable sectors. The effect of climate change is already apparent in many species and systems and over the next few decades climate change is expected to be a major driver of biodiversity loss.

Some species and systems are expected to be more vulnerable to climate change than others. In Australia, biodiversity hotspots such as south-west Western Australia and the Wet Tropics rainforests of Queensland are predicted to be highly vulnerable to climate change. Likewise, the rare endemic species that inhabit these regions, especially those with a restricted geographic range and specialised ecological requirements, are also projected to be at risk of decline and extinction. The recent [Biodiversity Vulnerability Assessment](#) (BVA) was a direct response to the task of undertaking a strategic assessment of the vulnerability of Australia's biodiversity to climate change.

But, we can reduce this risk by maintaining and enhancing the resilience of species and ecosystems. Integration of biodiversity concerns into climate change policy is crucial; the conservation and sustainable use of biodiversity can contribute both to mitigation and adaptation measures, for example, by maintaining old growth forests for carbon storage.

In Australia, it is hoped that IYB will present many opportunities to demonstrate the importance of biodiversity in our lives, and will provide the impetus to substantially increase current efforts to reduce the rate of biodiversity loss. Many events are planned across Australia, and more details can be found at: <http://www.environment.gov.au/biodiversity/iyb/index>.



NCCARF Genetic Translocation Workshop: Summary by Prof. Ary Hoffmann, University of Melbourne.

Threatened species can lose genetic diversity due to small population sizes resulting from habitat loss and fragmentation. Such populations are at risk of extinction, and the option of assisted migration has been the focus of recent debate. One type of assisted migration that is being increasingly discussed is genetic (rather than species) translocation, which focuses on moving individuals or gametes from one population to another *within* a species' current/historical range to enable gene flow and increase adaptive potential.

In this NCCARF workshop, held in Melbourne in April, participants discussed genetic conservation, and assessed the potential benefits and risks of this strategy as a conservation tool. Several problems were identified, including the likelihood of outbreeding depression and heterosis under environmental change. Outbreeding depression was considered problematic only when there had been substantial adaptation to different environmental conditions and/or a history of isolation between populations/taxa. However it was noted that the fitness benefits and costs of population crosses were rarely measured, particularly across multiple environments.

For threatened species, participants thought that levels of genetic diversity within populations should be considered within a risk assessment framework on a case-by-case basis, along with the benefits of introducing genes into target populations through decreasing levels of inbreeding depression. However, there will be fewer source populations with less genetic options available when planning genetic translocations for these organisms.

For non-threatened species, there will be more time to assess populations and genetic traits, and potential source populations can be more easily selected. When predicting the effects of genetic translocations, it should be possible to introduce small numbers of individuals and monitor them over generations to test for fitness changes over time. The issue of local adaptation was discussed at length, along with potential problems in its measurement. It was felt that new populations might be successfully created by mixing genotypes from several populations – which could then evolve further by selection and provide a level of pre-adaptation, although this issue needs further assessment.

Participants discussed components needed for risk assessment around genetic introductions, including levels of suspected inbreeding depression and heterosis, population size, and rates of gene flow, and an initial decision tree was developed. The risk of inbreeding depression could be estimated indirectly such as from chromosomal differences between populations. It was felt that translocation benefits should emphasise population size, because research indicates that populations should be maintained at a thousand or more to ensure evolutionary potential.

Overall the workshop participants felt that there were enormous benefits to be gained from genetic translocations, not only for threatened organisms but also for dominant species whose persistence might be threatened by climate change.



Genetic translocation could benefit both rare and common species under climate change.

Must Read

Hot off the press— papers and reports on climate change adaptation

- ◆ **Austral Ecology**, (2010), 35, Articles 2-5, pages 371 - 422.
This issue of *Austral Ecology* includes four original articles on climate change impacts and adaptation, including an article by McKellar *et al* (p371) on developing a research approach for impact assessment and adaptation planning, and two articles predicting impacts in Australia's biodiversity hotspots.
- ◆ **Special Section: Conservation Planning within Emerging Global Climate and Economic Realities.** *Biological Conservation*. (2010). 143, Pp. 1569 -1634.
This issue of *Biological Conservation* includes eight articles covering aspects of conservation planning under global climate change, including an article by Lindenmayer *et al.* (p1587) using Australia as a case study.
- ◆ **Use of Land Facets to Plan for Climate Change: Conserving the Arenas, Not the Actors.** (2010). Beier & Brost, *Conservation Biology*, 24,
This article advocates the use of 'land facets' for use in conservation and reserve planning under climate change. The authors suggest methods to define land facets, and stress that land facets should be used in conjunction with more common modeling techniques to design reserves and plan habitat linkages in the future. DOI 10.1111/j.1523-1739.2009.01422.x
- ◆ **Patterns of persistence and isolation indicate resilience to climate change in montane rainforest lizards.** Bell *et al.* (2010). *Molecular Ecology*, 19, 2531 - 2534.
This study compares responses to historical climate change in two lizards from the Wet Tropics, using spatial modeling, multi-locus phylogeography and phenotypic variation. Results suggest low dispersal and high persistence for both species across multiple isolated regions, and support the idea that isolated tropical montane species persist due to high resilience to climate change. DOI: 10.1111/j.1365-294X.2010.04676.x

Climate Change and Amphibian Malformations: Research Update from the USA

The impact of climate change on the transmission and spread of disease is a pressing concern. At the University of Colorado at Boulder, USA, PhD student Sara Paull is investigating how climate change could influence host-parasite interactions in the trematode parasite, *Ribeiroia ondatrae* (Rib), and its snail and amphibian hosts.

Rib reproduces in aquatic snails, releasing larvae which infect tadpoles and interfere with limb development. A variety of amphibians can be infected, most commonly frogs, and infected individuals often have one or more additional back legs, while others have malformed rear appendages known as bony triangles; many are eaten by birds – completing the life cycle of the parasite. Parasite malformations are suspected to have caused widespread frog declines in some regions.

Sara's studies indicate that increased temperatures can disproportionately increase the development rate of the parasite relative to its hosts. "Higher temperatures increase parasite abundance and infection of tadpoles," Sara explains. "There is also the potential for peak parasite abundance to shift to earlier in the year, which could increase malformations as early developing tadpoles are more sensitive to infection."

If Rib malformations do increase, it will be another blow for amphibian populations



Climate change could increase the spread and prevalence of amphibian malformations caused by the trematode parasite *Ribeiroia ondatrae*. (© J. Isaac)

already facing chytrid fungus, habitat loss, and hydrological changes associated with climate change. Rib has been found in migratory birds in North and South America, the Caribbean, and Europe. Although similar malformations have been found in frogs in NSW, there is no evidence to link the malformations with Rib or any other parasite at present.

In terms of adaptation management, Sara suggests, "Parasite-control measures, such as reducing snail numbers, could be a possibility for sensitive species in some areas."

Conference Update



2010 Aelert Conference: Diversity in Environmental Regulatory Responses. Rydges Lakeside, Canberra, ACT. 3-5th November, 2010. **Abstract submission open.** Details: <http://www.conlog.com.au/aelert2010/>

ESA 2010: Ecological Society of Australia. Sustaining Biodiversity –the next 50 years. Manning Clark Centre, ANU, Canberra, ACT. 6-10th December. **Abstract submission closes 30th July, 2010.** Details: <http://www.esa2010.org.au>

Greenhouse 2011: The Science of Climate Change. Cairns Convention Centre, Qld. 4 - 8 April, 2011. **Abstracts by November 19th, 2010.** Details: <http://www.greenhouse2011.com>

About the Adaptation Research Network for Terrestrial Biodiversity

The Adaptation Research Network for Terrestrial Biodiversity is one of eight Research Networks administered by the National Climate Change Adaptation Research Facility - www.nccarf.edu.au.

It is hosted by James Cook University in Townsville.



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