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NCCARF
National Climate Change Adaptation Research Facility
Adaptation Research Network TERRESTRIAL BIODIVERSITY

Terrestrial Research E-bulletin

Convener's Update

Welcome to our 8th issue of the TRE-bulletin.

News from our network this quarter includes the completion of the network Roadshows in June, the holding of an integrating workshop on Riparian Ecosystems and climate change adaptation with the Freshwater network on the 20th to 24th June in the Northern Territory and the release of a number of new Information Sheets in progress over the next few months.

Last issue, we included two articles on Ecosystem based Adaptation (EbA)—the main premise of this idea being that making our environment more resilient will help it adapt to climate change. EbA also supports the idea that human well-being is intrinsically linked to healthy, resilient ecosystems.

In support of this idea, the Australian Institute of Health and Welfare have recently launched a report which investigates the evidence linking the environment to human health.

The report makes a number of key findings, including that the environment can be a strong determinant affecting our health and the way human beings live.

The report also finds that the environment can impact on physical and mental health, and that humans can directly exacerbate or reduce health risks through their interactions with the environment.

This report is free to download, and a link is available in our 'Must Read' section on page 3, which also includes summaries of a number of other recently published climate change papers.

Also in this issue, we highlight climate change adaptation research taking place in New South Wales and the Australian Capital Territory, including a large-scale project aiming to build environmental corridors across the Great Eastern Ranges.

We also highlight research in WA investigating the adaptation potential of seeds of different native species under climate change, and a new project examining how some lizards have used morphological and physiological adaptions to move from the mesic zone to colonise arid regions.

We hope you enjoy this issue.

Steve Williams & Lesley Hughes

In this issue:

Meet the Steering Committee

Dr Jean-Marc Hero

Jean-Marc is Associate Professor at the Griffith School of Environment, at Griffith University, Queensland.

His research focuses on conservation and biodiversity, and he has an international reputation in amphibian research. In recent years, Jean-Marc has established a system of long-term ecological research sites as part of a Program for Planned Biodiversity and Ecosystem Research, measuring and monitoring the impacts of climate change.

Jean-Marc is Deputy Director of the Environmental Futures Centre at Griffith University, serves on the board of directors for Save The Frogs, and is Secretary General Elect for the World Congress of Herpetology.

He has published over 100 scientific works, including books, book chapters and refereed journal articles. He has supervised over 20 Honours and over 20 Postgraduate students.

Focus on New South Wales & Australian Capital Territory

New South Wales and the ACT experience a variety of climatic extremes - snow fall across the Alps in winter, extreme heat and dry in summer, as well as regular flooding across many regions. These extremes are expected to increase in the future - higher maximum temperatures, drier average seasonal conditions and increased winds during summer could lead to increased bushfire risk, while increased severity of storms may lead to catastrophic flooding events. It is also generally agreed that climate change will dramatically alter the ecology of the Australian alps, while the food producing capacity of the Murray-Darling Basin is also in doubt. This issue, we highlight adaptation research that is taking place in these southern regions.

Rethinking the 'local provenance' paradigm: Restoration ecology and climate change by Nola Hancock, PhD Student, Macquarie University.

Worldwide, ecological restoration projects are increasing and accurate seed sourcing guidelines are urgently needed for many species. Traditionally, seed has been sourced locally to "preserve" the genetic integrity of the replanted site. Local populations are perceived to be better adapted to local conditions resulting in superior survival, faster growth rates and increased restoration success.

But more recently, studies have shown that population size can be more important for restoration success than geographic distance when selecting source material. This information, together with a changing climate, is prompting a re-think of the traditional practice of using locally-sourced seed. As the climate continues to change, local conditions will alter and seed sourced locally may no longer be suitable or "adapted" to the new environment.

Open Top Chambers: raising temperatures over the summer months by 2-4°C above ambient gives a glimpse of possible future climatic conditions (© N. Hancock).

My research investigates the "local is best" paradigm in the Cumberland Plain in western Sydney. One component of this research investigates the differences between growth and survival of provenances of *Eucalyptus tereticornis* and *Themeda australis* when subjected to high temperatures.

Temperatures in western Sydney are projected to increase by 1.5 - 3ºC by 2050. Whilst the lower end of these predictions may not be too troublesome for hardy plants, the accompanying increase extreme temperatures may be fatal. In this experiment, half of the plants are enclosed in open top chambers (OTCs) heating the air inside by 2-4°C above ambient. Since the start of summer (2010/11), plants inside the OTCs have been subject to spikes of ≥ 45°C and to the "longest sustained period of temperatures > 30°C since records have been kept" (BOM). The experiment will continue to be monitored throughout the summer, recording survivorship and performance. These results will have implications for restoration management, providing guidance for practitioners to ensure their restoration efforts have long term sustainability.

The Great Eastern Ranges Connectivity Conservation Initiative – a strategic, whole landscape approach for conservation by Brendan Mackey, Fenner School of Environment and Society, Australian National University.

Australian species have used various strategies to persist through past climate changes such as local adaptation, dispersal and range contraction to refuges. However, contemporary changes overlay a suite of other threatening processes – including habitat loss and fragmentation; feral animals and invasive plants; and changed fire and hydrological regimes. These processes interfere with the natural adaptation processes that enabled species to persist through previous climate change. It is axiomatic that "big picture" thinking is needed if biodiversity is to persist even through this century and ecologically interconnected and intact natural lands maximise potential for species to adapt to climate change. The Great Eastern Ranges Connectivity Conservation Initiative is an example of a comprehensive and strategic approach which brings together people and organisations to establishing a conservation corridor along the 1,200 km New South Wales section of the Great Eastern Ranges.

Woodland corridor on the Shoalhaven River, Kosciusko to Coast link. (© DECCW Stuart Cohen)

Connectivity conservation is based on the concept of 'landscape corridors' that maintain or establish connections over thousands of square kilometres - extending biodiversity corridors to the landscape scale. Elements of landscape corridors include both dispersal corridors and ecological corridors. The term 'connectivity conservation' is widely used to capture an emerging consensus that: (1) we need management on lands around formal protected areas to buffer them from off-reserve threats and to care for biodiversity assets on other land tenures; (2) on cleared and fragmented land, large-scale restoration and rehabilitation is needed so protected areas are not isolated islands and 'extinction vortices'; (3) in largely intact areas, the ecological integrity *in toto* can be maintained through protected areas and off-reserve conservation management areas; and (4) conservation planning must factor in the large scale, spatially dependent, ecological and evolutionary processes essential for adaptation to environmental change.

The Great Eastern Ranges Initiative is built on community partnerships and aims to raise community awareness, and connect land holders with on-ground delivery programs utilising various conservation mechanisms. It acknowledges the role landholders, catchment authorities, government agencies, industries and the community have in conserving our unique biological diversity.

More: http://www.greateasternranges.org.au/images/stories/s2s/mackeyreport.pdf

Climate Change and Seeds by Anne Cochrane, Dept. of Environment and Conservation, Perth, WA.

Climate (specifically temperature and moisture) affects all ecosystem processes. Seed germination is one such process that is cued to temperature and rainfall events, with the particular cues that stimulate germination dependent on the type of plant species and the environment in which it lives.

In the Mediterranean climate of SW Western Australia many species germinate during the cool, wet autumn-winter period, thereby maximising the moisture in the soil for seedling establishment and subsequent survival over the following long hot dry summer months. If the climate changes as predicted, SWWA will become warmer and drier and there is the distinct possibility that the seeds of some species may no longer be in their optimal climatic space for germination, resulting in germination failure and potential population extinction.

My project has been investigating the temperature limits for germination in a range of SWWA native species whose only strategy for persistence in the environment after disturbance is through seed regeneration. These species are called obligate seeders. Using a temperature gradient plate I have been able to profile the temperatures over which germination does, and does not, occur, thereby identifying the temperature thresholds for germination.

Species with a wider temperature window for germination are less likely to suffer germination failure when the climate warms; species with a narrow temperature window for germination may become restricted in their seasonality of germination. To date I have been able to identify a number of species, both common and rare, that are potentially at risk of germination failure in a future warmer climate.

Temperature profiling can be a useful tool for highlighting conservation priorities. For example, if a species cannot germinate under predicted warmer conditions we gain some appreciation of its future vulnerability and can act accordingly to conserve it off site (for example in seed banks) or assist its establishment artificially. We can also identify suitable populations for restoration from our knowledge of how different seed lots may tolerate warmer conditions for germination. In addition, if we match the current and predicted temperatures for germination of a species across its geographic range to the germination temperature profile for that species we can increase the power of bio-climatic models.

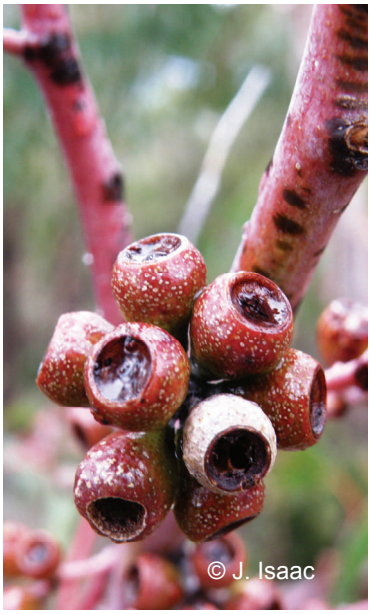
Banksia coccinea has a narrow temperature window for germination, and may be affected by climate change (© A. Cochrane)

Must Read

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

♦ **Rethinking species' ability to cope with rapid climate change** (2011) Hoff et al. *Global Change Biology* (online early). This study summarizes recent advances in geophysical research which show that despite rapid climate change that occurred in the Late Pleistocene which could have been more dramatic than contemporary changes. Despite this, few species extinctions are recorded for this period and the authors suggest this challenges current views on species extinction under climate change.

DOI: 10.1111/j.1365-2486.2011.02418.x



♦ **Health and the Environment: A Compilation of Evidence** (2011) Australian Institute of Health and Welfare, Canberra.

This government report investigates the evidence linking aspects of the environment, including temperature and UV radiation, and human health issues. It concludes that our surroundings, and the way we are altering the environment, can impact our health in a variety of ways. Download full report.

♦ **Increases in the flux of carbon belowground stimulate nitrogen uptake and sustain the long term enhancement of forest productivity under elevated CO_2** (2011). Drake et al. *Ecology Letters,* 14, 349-357.

This study investigates forest NPP under elevated CO_2 conditions. The authors find consistently elevated NPP are sustained by a C-cascade through the root-microbial system. DOI: 10.1111/j.1461-0248.2011.01593.x.

♦ **Designing nature reserves in the face of uncertainty** (2011). McCarthy et al. *Ecology Letters*, (online early).

This short letter investigates the SLOSS (single large reserves or several small) reserve debate in conservation theory by including uncertainty into models. The authors summarise that including uncertainty actually simplifies decision making.

DOI: 10.1111/j.1461-0248.2011.01608.x

Adapting to Arid Environments - Lizards as Model organisms

With much of the continent predicted to become hotter and drier with future climate change, the ability of species to adapt to a more arid environment will be a key factor in adaptation strategies for terrestrial biodiversity.

A new study, recently funded for four years through The Australian Research Council Discovery Grant scheme, will investigate how some lizards successfully evolved and adaptively radiated within the arid zone, while other closely related groups have not, and remain confined to the mesic zone.

The study will use lizards from the genus *Lerista* (above) and *Ctenotus* to understand how changes in morphology and physiology can promote adaptation into a more arid, hot environment (© M. Hutchinson)

The study will be led by Dr. Brett Goodman, and based jointly at the University of Adelaide and the South Australian Museum.

In particular, Dr. Goodman will be investigating what physiological and morphological traits were beneficial for colonisation, and radiation within the arid zone.

"While most other Australian skink lineages had similar opportunity, only a few species from a hand-full of genera succeeded." Dr Goodman explains, "The genera *Lerista* and *Ctenotus* have 80 and 100 species, and are the only groups to have successfully radiated within the Australian arid zone and still have representative species within the mesic-tropical and temperate zones."

The study will focus on the theory of adaptive radiation and utilise these two groups to assess how morphological traits such as limb length and a shift to a more snake-like movement could explain expansion into the arid zone. Physiological traits including oxygen uptake will also be assessed.

The results should have direct application to understanding how some species might adapt to contemporary climate changes. "By examining how traits changed rapidly in response to the extreme conditions encountered during the rapid formation of the Australian arid zone, this could help to forecast how some terrestrial species might respond to current climate change and the projected expansion of the arid zone." says Dr. Goodman.

In helping to reveal the evolutionary mechanisms which allow species to adapt and thrive in arid regions, this study could also inform management plans aimed at promoting adaptation in species faced with an increasingly arid environment.

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Conference Update

Sixth International Symposium on non-CO_2 greenhouse gases. 2-4 November 2011, Netherlands. Details: http://www.ncgg.info

Climate Change and Social Issues. 13-15 December 2011, Colombo, Sri Lanka. **Abstract submission by 31 May 2011.** Details: http://www.esc-toulouse.fr/m_articles.asp?id=1081

12th World Congress on Environmental Health: New Technologies, Healthy Human Being and Environment. 21 –27 May 2012, Vilnius, Lithuania. **Abstract submission by 30th November 2011**. Details: http://www.ifeh2012.org/welcome

NOTE":In Issue 7, we reported that Kerry Bridle heads the 'Biodiversity in Grain and Graze' project. This project has concluded—our apologies for this mistake.

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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