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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 the fourth edition of the TRE-bulletin. The Terrestrial Biodiversity Network has now been underway for just over a year and at this time we would like to reflect on our achievements to date and, of course, ask how can we improve our performance into the future.

To help us achieve this aim, we will be carrying out a short web based survey this month to ask our Network members for feedback to the committee. Respondents will be asked to answer ten questions relating to the kind of information you have found useful in the Network, and what you would like to see us provide in the way of resources and information in the future. We greatly appreciate any feedback that you can provide.

In this issue of TRE, we continue our 'Focus On' section to look at research underway on climate change adaptation in Queensland, including an interesting insight into how graziers might adapt to benefit both themselves and biodiversity, and how habitat refugia could prove critical for adaptation in rare rainforest species in Queensland's Wet Tropics.

Following on from our recently published Assisted Migration information sheet, we also bring you an update on plans for assisted migration of the critically endangered Western Swamp tortoise in WA, and report on a recent workshop on Climate change and the Murray–Darling Basin which took place in Canberra. And of course, we bring you our regular 'Must Read' and 'Conference Update' slots.

Next issue, we will be bringing you a summary of outcomes from the NCCARF funded workshop on Genetic Translocation, which was recently held in Melbourne. We will also have a special section on 2010 - Year of Biodiversity, and the implications for climate change adaptation and terrestrial biodiversity, and an article on climate change and limb malformations in amphibians in the USA.

In the meantime, we hope you enjoy this issue, and thank you for your support over our first year.

Steve Williams & Lesley Hughes

In this issue:

Meet the Steering Committee

Professor Hugh Possingham

Hugh is Professor of Mathematics and Ecology at the University of Queensland, the director of Australian Environmental Decision Analysis (www.aeda.edu.au) and an ARC Federation Fellow.

Hugh uses a variety of quantitative methods, including modelling, spatial analysis and decision analysis, to confront applied conservation problems and inform management decisions.

With over 300 publications, Hugh's research has contributed to many conservation issues, including reducing land clearing in Australia and rezoning the world's oceans. Hugh sits on 17 committees and boards, external to UQ, including the Wentworth Group, advising policy makers and managers on a variety of issues.

Focus on Queensland

From desert uplands to tropical rainforests, Queensland is a vast state offering a variety of terrestrial habitats. Indeed, the Wet Tropics rainforests contain more endemic terrestrial animals than any other region. But the climate across Queensland has already changed; daily temperatures have risen by 1°C state-wide, and rainfall and seasonality patterns have altered. Scientists predict that in the future we could see a decline in the extent of rainforest, severe coastal flooding and an increase in severe weather events, such as drought and high intensity cyclones, with likely catastrophic impacts for the state's biodiversity. Here we focus on some of the adaptation projects currently underway in the Sunshine State.

In Search of Cool Refugia by Dr. Luke Shoo

CTBCC, James Cook University, Townsville, Qld.

The Wet Tropics World Heritage Area has afforded protection to the tropical rainforests of Australia's north-east. Despite this, many researchers worry that contemporary climate change will spell environmental catastrophe for this ecosystem.

One tangible action we can take to minimise loss of biodiversity is to safeguard places where species are most likely to survive as the climate warms. These places, termed refugia, are areas in the landscape that are naturally buffered from extreme weather by features such as dense canopy, elevation, coastal influences and shading. These elements combine to generate unusually cool microclimates.

Cool refugia are already a critical component of the current protected area network. Around 45 per cent of the regions endemic rainforest species are found in just 25 per cent of the coolest rainforest and these limited areas of cool habitat could become increasingly important if species shift upslope in response to increasing temperatures.

With colleagues from the Centre for Tropical Biodiversity and Climate Change at James Cook University (funded by the Marine and Tropical Sciences Research Facility), I am working to identify climate refugia that could promote adaptation to climate change in rainforest species*. Major priorities are to identify existing refugia not currently included in the protected area network, along with sites where land degradation could potentially be reversed to strengthen refugia.

Climate refugia, such as Queensland's highest mountain, Bartle Frere, could be critical in helping some species adapt to climate change (© L. Shoo).

Targeted forest restoration can be achieved in a short time-frame - high density rainforest plantings yield foliage cover comparable to intact vegetation within 10-20 years and could increase the extent and connectivity of cool habitat. Longer periods are required (30-70 years) for less intensive plantings, and naturally established regrowth is another lower cost strategy. There is now an urgent need to assess whether forest plantings for carbon sequestration can be harnessed to help fund restoration efforts within important refugia.

***More Info: Shoo et al. Global Change Biology, in press.**

Helping Graziers Support Biodiversity Adaptation

Helping graziers adapt to climate change will benefit adaptation in many other terrestrial species which occur on grazing lands. (© T. Cornish).

Of Queensland's land area, nearly 90% is used for livestock grazing; predominantly cattle. As a result, much of Queensland's terrestrial biodiversity occurs on land used for cattle farming and ecosystem health is inherently connected to how farmers work their land.

In these regions, temperature and rainfall variation are the factors that determine not only biodiversity, but how rural communities manage the land. Under climate change, many cattle grazing regions are expected to experience increasingly variable rainfall and seasonality patterns, higher temperatures and more frequent extreme weather events such as floods and drought. Thus, the future of biodiversity on cattle grazing lands will be linked to the measures farmers take to adapt to climate change.

Using questionnaires, Network member Dr. Nadine Marshall, from CSIRO's Climate Adaptation Flagship, evaluated the adaptive potential of 100 cattle graziers in north Queensland*. She found that while these resource-users perceive themselves to be resilient to climatic variability, this perception may make them more vulnerable to future climate changes as they are less likely to use technology such as seasonal climate forecasts. "The problem is that many graziers are not planning for a future of environmental change." Nadine explains. "Not only will this increase their vulnerability and threaten their land, it makes it difficult to imagine how biodiversity might be maintained in the region. We need to increase the adaptive capacity of graziers in general – and I'm sure we can!"

She suggests that adaptive capacity can be influenced through a number of avenues such as assisting graziers to develop strategic skill sets and encouraging them to collaborate and plan for the future. The information generated through Nadine's work will help grazier communities become resilient to climate change and improve the sustainability of environmental assets.

***Marshall, N.A. (2010) Global Environmental Change, 20, 36-43.**

All Aboard the Ark? Assisted Migration Plans for Endangered Tortoises

As outlined in our recent information sheet[1], assisted migration is being considered as a management option to save some species from climate change, but a key challenge is identifying new sites where species can survive under future climates.

However, a new study, led by Network Member Dr Nicki Mitchell, from the University of Western Australia, aims to develop novel methodologies to identify ideal translocation sites for species threatened by climate change.

The project, funded by the ARC, with the Department of Conservation and Perth Zoo, will focus on Australia's most endangered reptile, the Western swamp tortoise (*Pseudemydura umbrina*). The tortoise will be used as a model animal to develop methods and test predictions against an historical data set.

Currently, the tortoise exists only in two ephemeral swamps near Perth; a geographic range of around 80 hectares containing about 70 individuals.

The unique life history and ecology of the tortoise mean it will be threatened by climate change in a variety of ways; it is reliant upon permanent water in winter, and breeding success and survival are dependent on rainfall and temperature .

The Western swamp tortoise hangs on in marginal habitat near Perth, but climate change could soon make this area too dry and hot for their continued survival (© Gerard Kutchling).

The study will utilise knowledge on the ecology and physiology of the tortoise, and different climate change scenarios, to develop models which predict where tortoises could survive if further warming and rainfall declines make their current range uninhabitable.

"Earlier tortoise translocations were in the wrong direction – north – where habitat is expected to become hotter and drier." explains Dr. Mitchell. "Our challenge is to identify suitable translocation sites in the south. To achieve this we are bringing together two disciplines – hydrology and biophysical modelling."

Ultimately, the researchers hope to use their results to guide the selection of new translocation sites for tortoises bred in the captive breeding program at Perth Zoo.

[1]: http://hosting2.arcs.org.au/terrestrialbiodiversity/download/information_sheet_2_assisted_migration.pdf

Must Read

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

- **Special Section - Ecological Responses to Contemporary Climate Change within Species, Communities and Ecosystems.** *Conservation Biology*, (2010), 24, p7- 77.

  This special section presents seven research articles and reviews on a variety of topics, including impacts, adaptation and conservation planning in terrestrial plants and animals.

- **Phenology, Ontogeny and the effects of climate change on species interactions**. (2010). *Yang & Rudolf* (2010) *Ecology Letters*, 13, 1-10.

  This paper presents novel methodology to enable phenology and ontogeny to be combined to better predict changes in species interactions as a result of climate change. DOI: 10.1111/j.1461-0248.2009.01402.x

- **Variation in gene expression of *Andropogon gerardii* in response to altered environmental conditions associated with climate change**. Travers *et al.* (2010), *Journal of Ecology,* 98, 374-382.

  This study investigates the impacts of climate change on gene transcription in a north American C4 grass. The authors find that gene transcription was more affected by thermal stress than water stress. DOI: 10.1111/j.1365-2745.2009.01618.x

- **Assessing the impact of climate change and land transformation on *Banksia* in the South West Australian Floristic Region.** Yates *et al*., (2010) *Diversity & Distributions*, 16, 187-201,

  The authors use MaxEnt to predict the impact of climate change on 18 species of *Banksia* in WA. The study finds the majority of species will suffer range contractions under the combined pressure of land transformation and climate change, and urge physiological studies to determine thresholds for key species.

  DOI: 10.1111/j.1472-4642.2009.00623.x

Climate Change and The Murray-Darling Basin: MDBA & NCCARF Workshop, Canberra, March 2010 - by Clive McAlpine, School of Geography, Planning and Environmental Management, UQ.

The aim of this workshop was to assess current research initiatives, and to initiate and plan integrated assessments and research programs focused on climate change impacts and adaptation strategies in the Murray-Darling Basin.

The workshop brought together researchers, industry representatives, and policy-makers working on climate change science, impacts and adaptation options relevant to the region.

Presentations highlighted climate change impacts on the southern Murray-Darling Basin. Persistent drought conditions and the step-decline in autumn and winter rainfall in Victoria over the past decade highlight the need to adopt the worst-case climate scenarios for water resource management and planning.

Concerns about biodiversity loss were raised, with one presentation highlighting risk of invasion and proliferation of exotic plant species under more variable hydrological conditions. The potential for biofuels to become weeds, declines in the condition of floodplain river red gum forests, and the loss of important ecological functions provided by soil invertebrates were also discussed.

The key message was that we should plan

Continued rainfall declines and drought are projected for the Murray Darling Basin, and will impact biodiversity and other sectors (© MDBA/ A. Mostead)

adaptation strategies based on the worst IPCC scenarios, moving away from impacts to solutions, and focussing on action and outcomes.

The final session of the workshop scoped out potential research projects to make the Murray-Darling Basin a world-class example of successful climate change adaptation. The organising committee will evaluate these project ideas as potential future collaborative research programs for the Basin.

Conference Update

FSBI annual conference: Fish and Climate Change. Queens University, Belfast, UK. 26 - 30 July 2010. Abstract submission closed. Details: http://www.fsbi.org.uk/2010/

95th ESA Annual Meeting:- Global Warming: the legacy of our past; the challenge for our future. Pittsburgh, Pennsylvania, USA. 1-6 August 2010. Abstract submission closed. Details: http://www.esa.org/pittsburgh/

Practical Responses to Climate Change Conference 2010: Meeting the Challenges from Catchments to Coast. Hilton on the Park, Melbourne, VIC. 29 Sept-1 Oct 2010. Abstracts by April 2nd. http://www.climatechange2010.org/

Climate 2010: Online Conference - Climate Change and Sustainable Management of Water Resources. 1 - 7 November 2010. Details: http://www.klima2010.net/

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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