



National Environmental
Research Program

TROPICAL ECOSYSTEMS *hub*



NERP Tropical Ecosystems Hub

Tropical Rainforest Research Snapshot

July to December 2013

Compiled by RRRC

ABOUT THE NERP

National Environmental Research Program

The overall objective of the National Environmental Research Program is to improve our capacity to understand, manage and conserve Australia's unique biodiversity and ecosystems. It will achieve this through the generation of world-class research and its delivery to Australian environmental decision makers and other stakeholders. The Program features five research hubs, including the Tropical Ecosystems Hub.

The Tropical Ecosystem Hub

The Tropical Ecosystem Hub is a \$61.89m investment that address issues of concern for the management, conservation and sustainable use of the World Heritage listed Great Barrier Reef and its catchments; tropical rainforests, including the Wet Tropics World Heritage Area; and the terrestrial and marine assets underpinning resilient communities in the Torres Strait.

Tropical Rainforest Node

The TE Hub supports 38 research projects, with eleven focused on Rainforests within three Programs:

- Condition and trends of North Queensland rainforests
- Threats to rainforest health
- Managing for resilience in rainforests

About this publication

This publication is a snapshot of the progress within the projects of the NERP TE Hub for the period July to December 2013.

For further information on the TE Hub and its structure please go to: www.nerptropical.edu.au

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Project 3.1: Rainforest Biodiversity

Prof. Steve Williams, JCU

Project Background

Understanding the present and future biodiversity patterns and drivers, and environmental and evolutionary refugia, is critical to establishing spatial and temporal prioritisation of vulnerable species and threats to maximise the effectiveness of management. This project maps these patterns in Wet Tropics rainforests under a range of climate change scenarios using a combination of available knowledge, existing datasets and strategic research to inform adaptive strategies for promoting persistence of biodiversity. The purpose of this research is to guide spatial planning in the Wet Tropics for the conservation of biodiversity.

Project Progress

The ongoing sampling of long term monitoring sites and the monitoring and ground-truthing of refugia areas has continued. This sampling has been a vital component of the data used in the modelling and analysis of future biodiversity impacts under the AR5 climate change/global emission scenarios:

- Under a low emission scenario (RCP 4.5), only ~10% of the endemic rainforest vertebrates are expected to be critically endangered by 2085; but
- Under a high emission scenario (RCP 8.5), similar to what we are tracking, suggests that nearly 60% of these species will be critically endangered.

Such information was incorporated into conservation prioritisation software identifying priorities based on species richness, turnover and endemism. While this work is ongoing, initial results suggest high concordance in priority areas that are identified for both present and future; these priority areas are similar to refuges through the last glacial maximum.

- The population and habitat modelling has shown that the most stable areas of the last 18,000 years, has harboured the least resilient species and that only the least vulnerable species have remained in areas of lower stability.

The key outputs here, supplemented with other NERP projects and data are significant. They are being used to draft a manuscript to be submitted to Nature by March 2014.

Project 3.2: What is at Risk? Identifying Rainforest Refugia and Hotspots of Plant Genetic Diversity in the Wet Tropics and Cape York Peninsula

Prof. Darren Crayn, Australian Tropical Herbarium

Project Background

Wet Tropics rainforests preserve one of the most complete and continuous records of Earth's evolutionary history and harbours much of the remaining Gondwanan flora. However, little is known about what or how much change



Morphological measurements are valuable to assessing genetic diversity within and amongst populations. Here, research assistant Nadiah Roslan is measuring the head-width of a Cogger's frog (*Mixophys coggeri*) before DNA collection. Image: CTBCC Image Library

has occurred. Where are the hotspots of this evolutionary history and what is the relationship between these endemic species and taxonomic hotspots? This project investigates the distribution of plant and fungal taxonomic richness, endemism, and genetic diversity across the Wet Tropics bioregion at the level of genus, species, and population. The purpose of this research is to provide a solid foundation for conservation prioritisation efforts in the region.

Project Progress

The understanding of patterns of phylogenetic diversity in the Wet Tropics was updated by integrating data from CSIRO on rainforest stability since the last glacial maximum.

The project has found a statistical correlation between the areas with high concentrations of non-Gondwanan plant lineages (i.e. lineages that have immigrated mostly from the northern hemisphere in the last c. 40 million years) and unstable rainforest areas. High stability rainforest areas - climate refugia - were correlated with higher concentrations of relictual Gondwanan plant lineages.

The work using DNA barcodes has shown that these genetic markers detect variation within approximately 100 out of 500 sampled species. The project team is currently exploring factors that explain this variation (such as biogeography) and/or issues this creates for the efficiency and accuracy of DNA barcodes as a means for identifying species.

Preliminary analyses suggest that the entire suitable habitat for the mountain top endemic plants restricted to above 1,000 metres in elevation in the Wet Tropics will disappear under future climate scenarios.

Project 3.3: Targeted Surveys for Missing and Critically Endangered Rainforest Frogs in Ecotonal Areas, and Assessment of whether Populations are Recovering from Disease

Dr. Conrad Hoskin, JCU

Project Background

Ten frog species disappeared from the upland rainforests of the Wet Tropics and Eungella during outbreaks of amphibian chytrid fungus in the late 1980s and early 1990s. However, the Armoured Mistfrog has been rediscovered during surveys in high elevation dry sclerophyll forest, very close to rainforest sites it from which it vanished. The population coexists with the chytrid fungus, suggesting the development of resistance, and that the other missing frogs may still be out there. This project investigates the degree to which some frog species have declined in the rainforest. The purpose of the research is to provide management recommendations regarding disease refugia for critically endangered rainforest frogs.

Project Progress

In September 2013, 40 critically endangered Armoured Mistfrog (*Litoria lorica*) were translocated from the



Mountaintop orchid species, such as *Bulbophyllum newportii*, may be impacted by future environmental change where warming reduces the extent of their cool, wet mountaintop habitat.

Image: Lalita Simpson (Australian Tropical Herbarium & JCU)

single known wild population to establish a second wild population. This involved collaboration between JCU, DEHP and the Western Yalanji Aboriginal Corporation. The translocated frogs are being monitored.

A highly distinct new frog species discovered at Cape Melville was described and named the Blotched Boulderfrog (*Cophixalus petrophilus*). The discovery of this and other new species at this site reveal the small area of rainforest at Cape Melville is unique and has been isolated from the Wet Tropics for an extremely long time.

Frog skin swabs from 21 dry sclerophyll sites have been analysed for the presence of chytrid fungus. Of the 637 waterfall frog (*Litoria nannotis*) swabs analysed so far, 296 (46%) came back as positive for chytrid fungus. The fungus was detected at all sites sampled. Importantly, intensities of infection varied greatly, ranging from 1 to 440,000 zoospores. The higher range of values is well above the threshold at which infections have been thought to be lethal, suggesting dry forest populations of amphibians might be able to tolerate high intensity of infection without showing signs of being diseased. Further analyses will examine the effects of class (male, female, juvenile), locality, climate and elevation to test patterns of prevalence and intensity of infection across sites and habitat types.

A long-term community frog monitoring program was set up with Kuranda EnviroCare to monitor endangered frogs in the Kuranda area. This covers 6 streams and focuses on several endangered frog species, including the Kuranda Treefrog (*Litoria myola*), Australian Lacelid (*L. dayi*) and the Mistfrog (*L. rheocola*).



Ingham is the only camp in the Wet Tropics, or north of Mackay, in which grey-headed flying-foxes roost. It is also one of the two camps in Australia in which all four main flying-fox species can be found. *Image: David Westcott*

Project 3.4: Monitoring of Key Vertebrate Species

Dr. David Westcott, CSIRO

Project Background

The Southern Cassowary and the Spectacled Flying Fox are the focus of repeated demands for management in the Wet Tropics. The species are frequently the focus of debate, often with financial and legal implications. In such circumstances, up-to-date information on population status, trends and distribution become key inputs into decision-making and conflict resolution, with good data critical to the process. This project monitors the abundance and distribution of these species in north Queensland. The purpose of this research is to inform decision making with regard to management of critical habitat for cassowaries; and management of agricultural and urban nuisance and future disease risks from flying foxes.

Project Progress

This project employs recently developed methods to monitor the abundance and distribution of the southern cassowary and the spectacled flying fox, including the drivers of the spatial dynamics of the populations.

A single bout of cassowary surveys were conducted in October and November with over 500 km of transects walked across the region. In total 903 dungs were found with 97 of these being fresh enough for collection. DNA extractions of the 97 fresh dungs are underway.

In addition, there were 82 sets of tracks encountered, 15 feathers found and 9 sightings of birds.

Monthly counts of flying fox were conducted at all known camps in the region. The past year has seen the usual strong seasonal fluctuation of flying fox numbers through the year. This year, however, the project team saw numbers decline to just 10,537 in July 2013, the lowest total count recorded since this work began in 2004. These numbers are now gradually increasing and in November 2013, stood at 56,000 as animals move back into camps. The results show a return to the dynamics observed in non-cyclone years.

The findings from this project are instrumental in guiding the development of the National Flying Fox Monitoring Program.

Project 7.1: Fire and Rainforests

Dr. Dan Metcalfe, CSIRO

Project Background

Australian rainforests have persisted for millennia in an environment where fire is common. This project increases understanding of the rainforest and fire dynamic, its impact on key species, and informs fire management in the Wet Tropics region. Fire management protocols in the Wet Tropics rainforests are

based on limited experimental data. As other processes increasingly threaten some fire-affected habitats, this lack of hard data becomes critical. The purpose of this research is to address key questions in relation to fire and habitat management in the Wet Tropics.

Project Progress

Results to date include:

- Lowland sclerophyll woodland invaded by rainforest species has been burnt in the Tully-Cardwell area of the Wet Tropics. The project found that all species are affected by fire with many sclerophyll species re-sprouting and rainforest species germinating from seed, suggesting that a very large seedbank of rainforest species underlies much of the invaded woodland community. On-going growth and changes in species composition are being monitored.
- Fire is known from the margins of Mabi forest, especially where it abuts blue-gum swamp. Weather stations installed are comparing microclimatic conditions inside and outside the forest to measure litter curing rates and to allow comparisons with historic weather data. Litter will be experimentally combusted under controlled conditions early in 2014, allowing determination of litter dryness and microclimate that supports fire. Field sampling of litter curing will link the weather and experimental data, enabling prediction of the potential frequency of fire events in Mabi rainforest.

- Littoral rainforest is critically endangered, and while fire is recognised as a threatening process, intense cyclones and human activity are proving far more damaging. A pilot study has completed a revised mapping protocol for Wet Tropics littoral rainforest, with the input of Federal and State government employees, regional and local community groups including the Djiru people.

Meetings with Traditional Owner groups are planned with Giringun Aboriginal Corporation and the Rainforest Aboriginal People's Alliance to ensure traditional ecological knowledge informs any fire management recommendations.

Project 7.2: Invasive Species Risks and Responses in the Wet Tropics

Dr. Helen Murphy, CSIRO

Project Background

Invasive species management in the Wet Tropics is currently driven by a species focused approach. However, land managers in the region are increasingly recognising the need for regional-scale approaches that incorporate consideration of the ecological processes that enable invasive species to spread. In addition, climate change and intense cyclones will enhance the capacity of non-native species to establish. The project assesses current and future invasive species risks and responses in the Wet Tropics. The purpose of this research is to provide

managers with tools for prioritising management activities at a regional scale, and allocating resources and effort on the ground.

Project Progress

The project has published or submitted a series of papers including:

- Those on the science of containment as a management strategy for invasive species. Containment is a strategic option that is frequently advocated for dealing with invasive weeds and is often presented as the fallback option when eradication attempts are abandoned. In this series of papers, it is argued that many infestations are no more amenable to containment than eradication, and containment programs are not necessarily more economic or more effective in the long-term.
- In other published papers the emerging potential for biofuel species to pose biosecurity risks in Queensland is considered. While biofuel crops offer potential benefits to a world adjusting to the challenges of climate change, the plant attributes that make for successful biofuel crops are frequently the same as those that make for successful invasive species.

The project has contributed to a template for the Pest Adaptation Response Strategy that was presented to stakeholders at the Far North Queensland Pest Advisory Forum in November 2013. The project is also has 61 climate models for weeds that occur in or adjacent to the Wet Tropics that will contribute to the development of prioritisation strategies across various NRM regions.



Feral pig captured on a camera trap beside the pig impact monitoring site at Ella Bay. Image: Matt Bradford



Project 7.3 leader, Justin Welbergen, is about to release a golden bower bird, *Prionodura newtoniana*, following measurements of its thermophysiology.
Image: Johan Larson

Project 7.3: Climate Change and the Impacts of Extreme Climatic Events on Australia's Wet Tropics Biodiversity

Dr. Justin Welbergen, JCU

Project Background

Tropical rainforests are the hotbed of the world's biodiversity. However, the vulnerability of tropical rainforest biota to extreme temperature events is largely unknown. This is of concern because tropical species may already be living closer to their maximum thermal tolerances so that even small temperature changes could have disproportionally large impacts. This project investigates the exposure and sensitivity of Wet Tropics animals to extreme climate and weather events, such as heat waves, fires, flooding, rain and cyclones. The resulting information will be used to assess and map the vulnerability of biodiversity to the impacts of current and future extreme events. The purpose of the research is to guide conservation planning and management in the Wet Tropics.

Project Progress

The project has identified the areas in the Wet Tropics landscape where vertebrates currently are: i) most vulnerable to temperature extremes ('thermal hotspots') and ii) least vulnerable to temperature extremes ('thermal refugia'). Depending on end-user needs, the project can now map these areas for any vertebrate (assemblage)

anywhere in the Wet Tropics at 250m resolution. The vulnerability analyses combine detailed information on thermal exposure at the microhabitat level with data on thermal tolerance, behavioural acclimation, and the capacity of a population to recover from a (heat-induced) reduction in fitness. The analyses are the most comprehensive to date combining quantitative information on exposure and sensitivity to extreme temperature events. The current thermal hotspots (e.g. Tully River catchment) are important for habitat restoration and species conservation because they represent:

- Areas where vulnerable species would benefit most from promotion of thermally sheltered microhabitats, such as understory and logs.
- Areas that contain relatively heat-tolerant individuals, key for translocations as a tool for wildlife conservation under climate change.
- The current thermal refugia (e.g., Mt Windsor and the Carbine Tablelands), on the other hand, represent areas where vulnerable species would benefit most from habitat preservation.

However, the current thermal hotspots and refugia are expected to change significantly under climate change, both in terms of their spatial extent and species composition, limiting the usefulness for long-term conservation management. Therefore, the next aim is to define thermal hotspots and refugia under a range of emission scenarios, essential for prioritising conservation actions under climate change.

Project 12.1: Indigenous Co-management and Biodiversity Protection

Dr. Rosemary Hill, CSIRO

Project Background

Planning systems, governance structures and institutions that capture the traditional knowledge and associations of Indigenous peoples into biodiversity decision-making and management remain elusive. Whilst there have been advances in the institutional capability to engage Indigenous peoples into biodiversity management, a gap remains between the current status and aspirations for equitable co-management arrangements of conservation areas. This project undertakes co-research with Indigenous peoples and protected area managers in north Queensland to understand the capability of Indigenous Protected Areas and other collaborative models. The purpose of this research is to identify the conditions under which these arrangements could lead to effective joint management of the Wet Tropics.

Project Progress

The Interim Participatory Evaluation provides the first spatially-located analysis of co-management in Australia. Both the Girringun and Rainforest Aboriginal Peoples Alliance workshops assessed that the structures, processes and results for the Rainforest Aboriginal Peoples 'Keeping Strong' parts of the framework as in better health than those for 'Keeping Engagement Strong'.

The results to date resonate with the concept of the creation of an equitable intercultural space as the key means of achieving co-management. Indigenous Protected

Areas were identified as the most useful tool for creating an equitable intercultural space. Key aspects that underpin their usefulness include adaptability, flexibility, inclusiveness of multiple tenures, ability to build progressively over time, and to foster collaborative partnerships.

Both qualitative and quantitative data contribute to the evaluation. Workshop one, hosted by Girringun Aboriginal Corporation, provided data informed by the nine tribal groups that are represented therein. Workshop two, hosted by RAPA, provided data informed by the wider twenty tribal groups across the region of wet tropics country. The evaluations focused on the 13 parts of the derived framework. A health rating of 1 to 5 (where 1=very sick; 5=excellent health) was given to three indicators (structures, processes and results) for each part of the framework at both workshops, and the reasons for the ratings discussed in small groups. Further rounds of data collection with many other participants in co-management are needed before the participatory evaluation will be complete.

Project 12.2: Harnessing Natural Regeneration for Cost-effective Rainforest Restoration

Prof. Carla Catterall, GU and Dr. Luke Shoo, JCU

Project Background

There is a need to find low cost options to restore critical habitat over large areas. This project measures and monitors the rate and pattern of vegetation development in both replanted sites and re-growth sites. The project combines three inter-related approaches: field investigation



Coarse woody debris pile constructed from salvaged logs. This log pile was installed in a young restoration planting in tropical northeastern Australia as part of an experiment to evaluate the extent to which recovery of animal communities can be accelerated through artificial supplementation of microhabitat features. Image: Luke Shoo (UQ)

and data analyses of how re-growth rainforest develops and how it differs from replanted rainforest; field trials of novel approaches to accelerate re-growth development; and landscape analysis to identify areas of highest potential for low-cost re-growth. The purpose of this research is to provide decision-support options to optimise regional investments using the most appropriate restoration method for any particular ecological and economic scenario.

Project Progress

The project focuses on three objectives:

- Outcomes and rate of regrowth vs replanting: a network of 29 sites that differ in their age of regrowth across an area of about 40 km by 22 km in the Atherton Tablelands was finalised. Surveys of vegetation and flora were completed. Preliminary analyses to investigate rates of regrowth development have been performed.
- Regrowth acceleration information review and field manipulation: a paper “Putting it back: woody debris in young restoration plantings to stimulate return of reptiles” was accepted for publication in *Ecological Management and Restoration*. The main finding is that, after one year, the addition of woody debris within restoration plantings can increase the local abundance of reptiles and promote colonisation of at least one log specialist. Also, an Honours



Accessing the WTWHA via Skyrail. Image: Michelle Esparon

thesis was completed that evaluated outcomes for seedling recruitment from the first 20 months of field regrowth acceleration “kickstart” trials. These involve investigation of several different treatments aimed at facilitating the recruitment of rainforest seedlings. The results demonstrate the importance of grass suppression and structure for promoting seedling recruitment.

- Decision processes analysis and modelling: the project team began to combine field measurements of regrowth vegetation with estimates of age and measures of landscape context to investigate factors that constrain or facilitate development of regrowth. The project also initiated discussions with researchers in the NERP ED Hub about how to extend and apply structured decision making and available analytical tools to inform allocation of resources to restoration.

Project 12.3: Relative Social and Economic Values of Residents and Tourists in the Wet Tropics World Heritage Area

Prof. Natalie Stoeckl, JCU

Project Background

Understanding the manner in which communities in the Wet Tropics and the people who visit value the region's key environmental assets assists prioritization of the values held dearest. This project fills critical information gaps about the relative importance of key attributes (or ‘values’) associated with the WTWHA to a variety of different stakeholders and about the way in which those values might be affected by a range of external influences (e.g. different types of economic development, increases in population, changes in the mix of visitors). The purpose of this research is to test non-monetary values against traditional economic valuations for conservation planning and management.

Project Progress

A total of 602 surveys have been received, of which 365 are from non-indigenous households and 81 from Traditional Owners, giving a total of 446 resident surveys, while 156 are from tourists.

Preliminary survey results from the project's tourist sample indicate that:

- More than half (58%) were repeat visitors and the majority of visitors (85%) were satisfied with their experience.
- When hypothetical ‘changes’ to the WTWHA were proposed, visitors reacted negatively saying that they would not have come at all or would have reduced the length of their stay.
- This suggests if the hypothetical ‘changes’ occurred, the region could lose substantial tourism revenues as fewer visitors and/or shorter visits implies less tourist expenditure. However, most visitors said they would not be willing to contribute financially to a fund set up to help address some of the threats to the rainforest.

Preliminary results from the residents survey indicate that:

- Most residents would not move away from the region even if some of the values of the rainforest were to deteriorate (77% and 60% of Indigenous and non-Indigenous, respectively) and were generally satisfied with their overall quality of life (84% and 87% of Indigenous and non-Indigenous, respectively).
- The Indigenous respondents ranked social connections and the protection of their culture highest in importance. While the safety of family and friends was an important contributor to overall life satisfaction by the non-Indigenous respondents, having quality infrastructure and some control over their lives were also essential elements to life satisfaction.
- An overwhelming majority of residents echoed the views of visitors for hypothetical 'changes'. Residents agreed it was not only their responsibility to care for the WTWHA and most were not prepared to pay to mitigate threats, unless all other WTWHA users pay too.

Prior to the workshop the new Torres Strait e-Atlas was setup including a regionally branded section of the e-Atlas website, a regionally specific mapping portal and a regionally specific metadata search tool. Four general knowledge articles were written and added to the new site covering the topics of seagrass, dugongs, shipping and water quality. In addition to this a new satellite and aerial imagery basemap was developed for the Torres Strait region.

In June 2013 all NERP TE projects submitted spatial information about their project activities to the e-Atlas. These are now available as a series of maps from the e-Atlas site.

Project 13.1: e-Atlas

Dr. Eric Lawrey, AIMS

Project Background

The e-Atlas is a website, mapping system and set of data visualisation tools for presenting research data in an accessible form that promotes greater use of this information. The e-Atlas serves as the primary data and knowledge repository for all NERP Tropical Ecosystems Hub projects. The e-Atlas captures and records research outcomes, making them available to research-users and hosts meta-data records, providing an enduring repository for raw data. It is also developing and hosting web visualisations to allow viewing of information using a simple and intuitive interface. In doing so the e-Atlas is assist scientists with data discovery and allowing environmental managers to access and investigate research data.

Project Progress

In the last six months the e-Atlas team has focused on the development reference datasets and the development of the Torres Strait e-Atlas.

An improved basemap, called the *Bright Earth e-Atlas Basemap* was developed and released. It focuses on Queensland mainland and Great Barrier Reef, highlighting the natural environment and the areas of human influence rather than a traditional roadmap such as Google Maps. This new basemap was requested by and delivered to the BOM eReefs Water Quality Dashboard team and is now the default basemap for the e-Atlas.

In November 2013 a series of workshops was run in the Torres Strait to road-test the progress-so-far on the Torres Strait e-Atlas with representatives from key end-users including the TSRA, AFMA and Tagai College. This workshop provided valuable feedback to the team helping to identify several areas of priority development and problems with server performance under load, which have now been largely resolved.



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Australian Government
Department of the Environment



RRRC
PO BOX 1762, Cairns QLD 4870
07 4050 7400
enquiries@rrrc.org.au