



Australian Government

Department of the Environment, Water, Heritage and the Arts

Marine and Tropical Sciences Research Facility Milestone Report, November 2009

Program 4: Species and communities of conservation concern

Project 1.4.3: Rainforest threatened species and communities and ecosystem processes

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Summary

Work in this quarter has focussed on meeting outstanding objectives and communicating outcomes to colleagues, stakeholders and the public. All objectives and sub-projects are on target, and extensive efforts are going towards providing research findings to policy and management agencies. Extensive collaboration between projects is supporting a range of additional outputs.

Project Results

Objective: Littoral rain forest (incorporating lowland basalt rain forest) mapping (CSIRO)

We have surveyed six littoral rain forest sites to date, and are scheduled to survey a further two sites with Cassowary Coast Regional Council on 26 November. A further twenty site surveys have been identified which we have conducted in the past and for which we can supply data; these include five sites where changed burning regimes are permitting littoral rainforest species to invade formerly open woodland habitats (see Figure 1). Surveys of Stephens and Sisters Islands, the volcanic source of the basalts at Clump Point, will be surveyed after February 2010, as the islands are currently home to breeding populations of terns. Marine Parks has approved our request to land and will facilitate our surveys when they deem the tern numbers to have decreased to a level where we not cause any significant disturbance. These data will be supplied (i) to Terrain NRM Ltd to support the Mission Beach Habitat Action Plan, by highlighting the botanical and geological significance of the Clump basalt, (ii) to the Queensland Department of Environment and Resource Management, to suggest changes to current Regional Ecosystem designation, (iii) to Wet Tropics Management Authority to highlight the importance of the area for their reporting, (iv) to CCRC to support their management of coastal vegetation, and (v) to DEWHA to highlight the limitations of existing statutory definition of Littoral Rainforest and Coastal Vine Thicket under the *Environmental Protection and Biodiversity Conservation Act* for the Wet Tropics Bioregion; we have been involved in extensive discussions with CCRC, WTMA, C4 and DEWHA Compliance Office over limitations in designation and their impact on preventing current forest clearing activities in the South Mission Beach area.

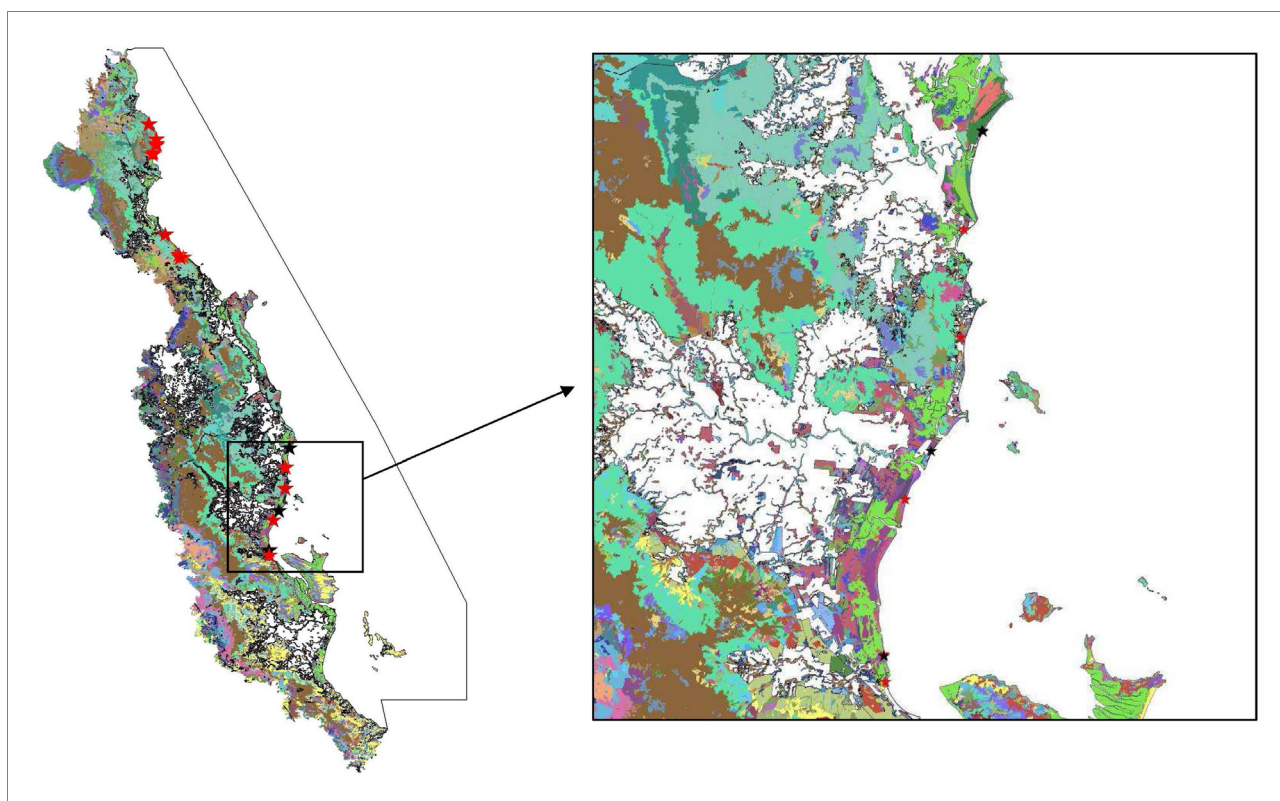


Figure 1: Location of Littoral Rainforest and Coastal Vine Thicket surveys in the Wet Tropics bioregion, and (inset) the Mission Beach area.

Objective: Impacts of climate change (CSIRO)

Dr David Hilbert (MTSRF Project 2.5ii.3) has been developing decadal projections for vegetation trajectories between 2020 and 2080 using four climate change scenarios based on data layers shared with Dr Suppiah Ramasamy (MTSRF Project 2.5ii.1). We have compared the predictions of the A1FI high temperature (+5°C) and lower precipitation (-20%) scenario with the pre-clearance Regional Ecosystems as inferred by Queensland Herbarium. These show a number of differences (e.g. see Figure 2), with predicted transitions resulting in a much simplified lowland habitat. For example, reduction in the extent of *Melaleuca* woodlands and associated wetland habitats may mean that restoration plantings need to consider planting mesophyll rainforest species today to ensure that the community which develops matches the hydrological environment which exists at their time of maturity, and to avoid planting communities which will be forced to exist in a constant successional state for decades to come. These data are being written up into a manuscript with an expected submission for internal review by early 2010.

On submission of the manuscript, our findings will also be written up into a technical report for dissemination to local management agencies.

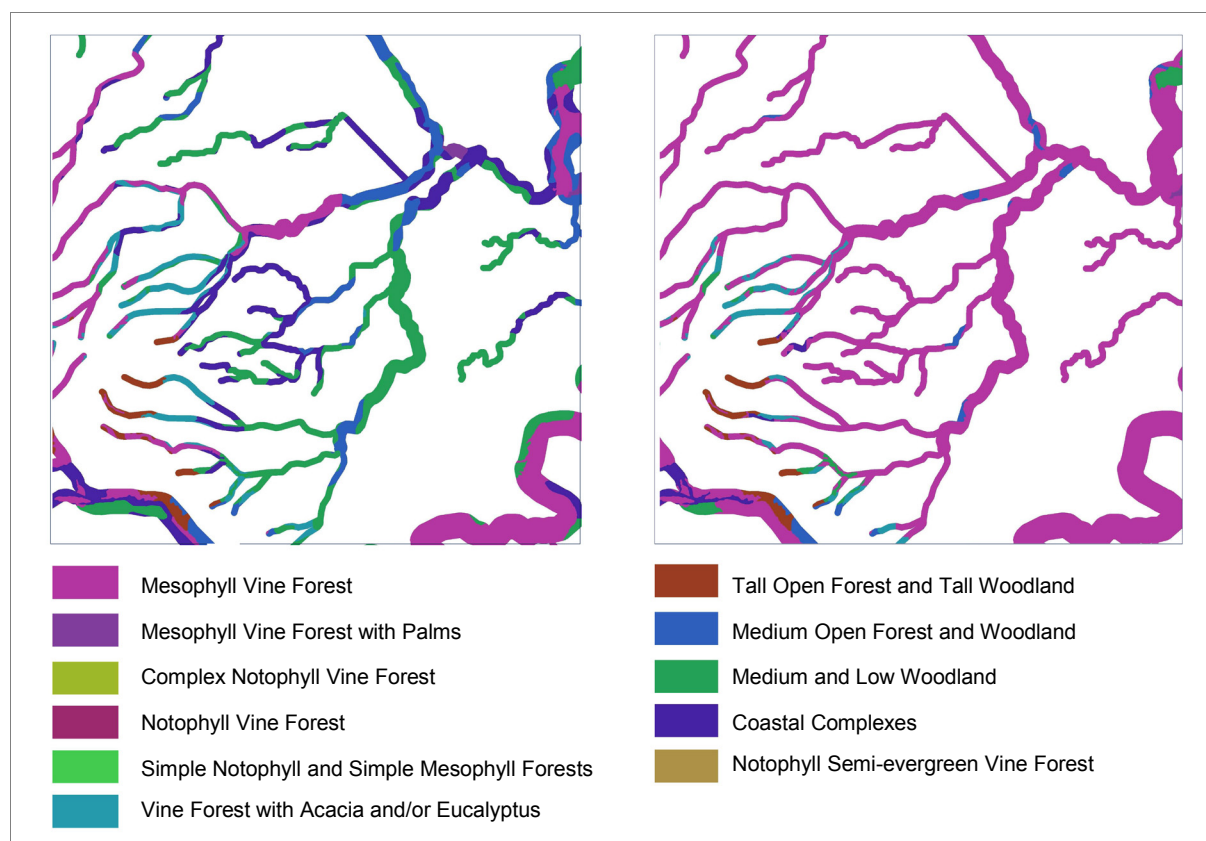


Figure 2: (Left) Pre-clearance Regional Ecosystems, and (right) the same ecosystems under the climate change scenario.

Sub-project: Cassowaries and flying foxes (CSIRO)

Cassowaries: Dr David Westcott participated in the WTMA Cassowary Summit as an invited speaker, when he presented the outcomes of MTSRF research, and as a panel member. Dr Westcott also participated in the WTMA Cassowary Research Workshop, presenting results and interpretations to colleagues and community groups.

Two more rounds of community cassowary surveys have been completed in local areas at Mission Beach and Kuranda; samples have been sent to the USA for sequencing.

Dr Westcott provided comments on DEWHA's Draft Policy Statement, 'Significant Impact Guidelines for the endangered southern cassowary (*Casuarius casuarius johnsonii*) Wet Tropics Population, July 2009.'

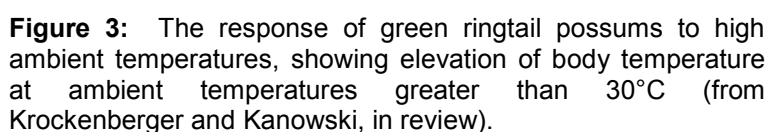
Flying foxes: Continued monthly censuses of spectacled flying foxes have been carried out, and are helping to document temporal shifts in population distribution and the effects of food-source availability on movement patterns.

Sub-project: Mechanisms of climate change impacts on threatened species (JCU)

Preliminary report on physiological tolerances of arboreal marsupials

This sub-project/objective was focused on determining the responses of Herbert River ringtail possums (*Pseudochirulus herbertensis*) and Lemuroid ringtail possums (*Hemibelideus*

The pattern of response to high ambient temperature in green ringtail possums was a rapid and linear rise in body temperature dependent on the time they were exposed to ambient temperatures greater than 30°C (Figure 3). Krockenberger and Kanowski (in review) interpreted this pattern as a water conservation strategy – allowing body temperature to rise, thus storing excess heat for a period rather than utilising scarce water (scarce during the dry season due to limits on foliage intake imposed by plant toxins) for evaporative cooling. The excess heat can then be shed without recourse to evaporative cooling later in the evening when ambient temperatures fall. Given the rate of body temperature rise under these conditions in green ringtail possums, this strategy relies on ambient temperatures rising above 30°C for no more than about four hours per day, a limit that corresponds well with the rapid decline in possum density at sites where the average maximum temperature of the warmest week of the year is above 30°C.



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the ringtail possums, and the variation in the rate of temperature rise and threshold temperature between the species matches well with our expectations based on the differences in their altitudinal ranges- suggesting that Lemuroid possums are also likely to be limited by temperature extremes and negatively impacted by increases in the frequency and severity of those extremes as predicted under most climate change scenarios. This also gives us confidence that the mechanism proposed by Krockenberger and Kanowski (in review), that distribution of green ringtail possums is limited by an interaction between limitations on water intake imposed by plant defensive compounds and the requirements for evaporative cooling imposed by environmental extremes, has more general applicability to rainforest ringtails and may well provide a general mechanism for understanding limitations of the distributions of all marsupial folivores.

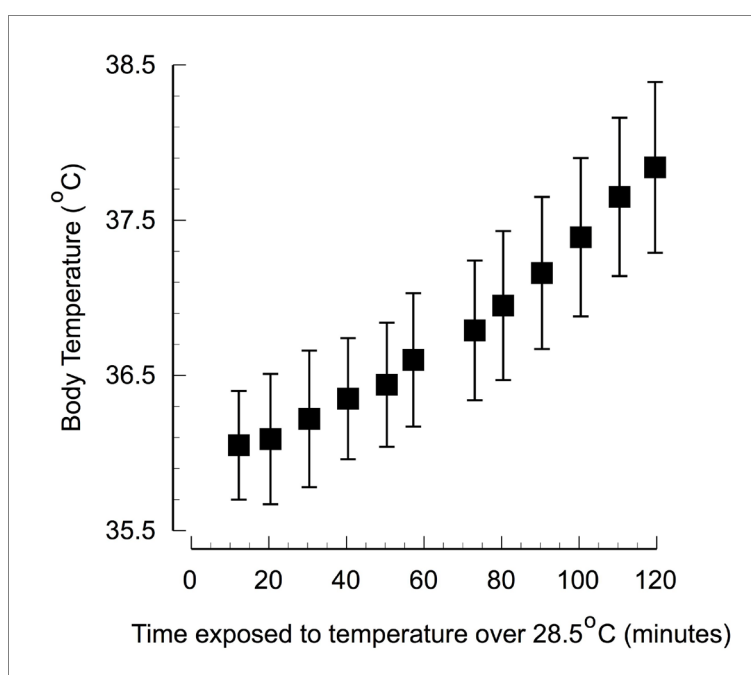


Figure 4: The response of Lemuroid ringtail possums to high ambient temperatures, showing elevation of body temperature at ambient temperatures greater than 28.5°C.

Preliminary results on physiological tolerances of microhylid frogs

The Environmental Protection Agency permit (No. WITK054668508) to carry out the physiology experiments was issued in November 2008.

The physiological parameters that have been gathered for each species are:

- Maximum temperature tolerance;
- Minimum temperature tolerance;
- Preferred temperature;
- Dehydration rate under exposure to dry air at 20°C; and
- Metabolic rate based on O₂ consumption and CO₂ production under exposure to dry air at 20°C.

To collect the maximum and minimum tolerance temperatures the frogs were set into a cylindrical chamber in a water bath to increase or decrease the temperature. The maximum and minimum temperature at which the frog could not respond to a stimulus was recorded. The stimulus is slow rotation of the chamber, which is accompanied by recovery of the frog's normal posture.

The preferred temperature has been measured using a thermal gradient (from 7-40°C) that allows the frogs to move freely and choose their own temperature. A digital image is recorded of the frog's position within the gradient each minute over the two-hour measurement period, and temperature is recorded continuously at 100mm intervals along the gradient, allowing a temperature to be interpolated for each position along the gradient.

Water loss rates have been collected using flow-through respirometry – providing a temperature and humidity-controlled air flow over the frog and analysing the air stream for flow-rate, O₂, CO₂ and water vapour. This allows calculation of metabolic rate, and instantaneous water loss rates. The overall water loss can be calculated by comparing the initial and final weight of the frog.

To date, four localities have been visited and between seven and eight species of Microhylid frogs (genus *Cophixalus*) have been surveyed. 73 individuals have been tested in at least one experiment to get any of the parameters (Table 1).

Table 1: Summary of locations, species, number of individual tested, and physiological parameters.

Location	Species	No. Ind.	Percentage of weight lost in 30 mins.	Temperature parameters		
				Maximum	Minimum	Preferred
Thornton Peak	<i>Cophixalus coccinus</i>	18	9.58 (n=1)	29.02 (n=6)	14.2 (n=1)	18.86 (n=8)
	<i>C. aenigma</i>	7		-	-	20.27 (n=2)
Atherton Uplands	<i>C. ornatus</i>	8	8.26 (n=8)	32.98 (n=6)	16.07 (n=5)	28.61 (n=8)
Carbine Uplands	<i>C. hosmerai</i> , <i>C. aenigma</i> or <i>C. monticola</i>	14	10.65 (n=9)	25.62 (n=8)	18.8 (n=3)	23.8 (n=6)
	<i>C. hosmerai</i>	3	5.03 (n=4)	31.9 (n=3)	9.51 (n=3)	23.68 (n=3)
Bellenden Ker	<i>C. neglectus</i>	4	7.1 (n=8)	29.43 (n=3)	13.6 (n=4)	22.25 (n=2)
Mt Windsor	<i>C. bombiens</i>	3	12.96 (n=3)	28.13 (n=3)	12.63 (n=3)	26.84 (n=3)

In the case of the Carbine Uplands locality, three species of *Cophixalus* occur at the study areas and since most of them have not been found calling (this is the only reliable non-molecular identifying characteristic), DNA samples must be used to identify their species. This is underway. Preliminary examination of the data suggest some physiological variation between species, but given that the sample sizes are low and species ID unclear until the molecular identification is complete, it is premature to supply them here.

Field collection of the physiological measurements is continuing this wet season.

Communications, major activities and events

1. Laliberté, E., Wells, J., DeClerck, F., **Metcalf, D.J.**, Catterall, C., Queiroz, C., Aubin, I., Bonser, S., Yi, D., Fraterrigo, J.M., McNamara, S., Morgan, J., Sánchez Merlos, D., Vesk, P. and Mayfield, M. (2010) Land use intensification reduces functional redundancy and response diversity in plant communities. *Ecology Letters* 13: 76-86 [[doi:10.1111/j.1461-0248.2009.01403.x](https://doi.org/10.1111/j.1461-0248.2009.01403.x)]
2. **Metcalf, D.J.**, Ford, A.J., Lawson, T. and Murphy, H.T. (2009) [The Roles of Invasive Species in Tropical Fragmented Landscapes](#). Invited talk: Symposium 23 *Plant functional diversity in human-modified landscapes*. INTECOL 2009, Brisbane, August 2009.
3. **Metcalf, D.J.** and Ford, A.J. (2009) [A re-evaluation of Queensland's Wet Tropics based on 'primitive' plants](#). *Pacific Conservation Biology* 15(2): 80-86.
 - a. 'Timeless tropical bloom' reported in the *Brisbane Courier Mail*, General News, page 20 (24/7/2009);
 - b. 'Ancient wonders found' reported in the *The Cairns Post*, Environment, page 18 (30/7/2009);
 - c. 'Daintree even more ancient' reported in the *Port Douglas & Mossman Gazette*, General News, page 4 (30/7/2009).

This project will be highlighted in an invited presentation to a Threatened Species Event to be held at Nature's Powerhouse, Cooktown, 12 December 2009, entitled 'Threatened Plant Species of the South Cape York Catchments'.