TWO TOWERS IN THE TROPICAL RAINFOREST: A DOUBLE CHALLENGE

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MTSRF Project 5.ii.2

- **Sub-project 1**: Is there a measurable change in carbon, water or sensible heat fluxes that can be attributed to climate change perturbing the rainforest?
- **Sub-project 2**: Are there changes in physiological behaviour or productivity in the rainforest that can be attributed to climate change.
- **Sub-project 3**: Determining the potential effects of changing climate on the fluxes of water and carbon through the soil profile.
- **Sub-project 4**: Examining the flowering and fruiting responses of the plant community to climatic stress.
- **Sub-project 5**: Climate variability vs resource driven variation in insect populations.
Two Towers

Sub-project 1:
Fluxes vs Climate Change
Mike Liddell (JCU)

- **Station 1: Cape Tribulation**
  Based at the Australian Canopy Crane
  this station has been operating since March 2001.

- **Station 2: Cow Bay**
  Based at the Daintree Discovery Centre
  has been in operation since December 2008.
Satellite Imagery
Cape Tribulation
LANDSAT
80m resolution
- Both sites are in complex terrain.
- Only daytime flux data is being used for long term analyses.
Daintree Forest

- Pristine lowland rainforest at both stations.
- Complex Type 1A mesophyll vine forest
- Canopy height 25-35m – dependant on topography/soils.
- Leaf area index Station 1 ≈ 4 (Amazon 8-10)
- High species diversity Station 1: 88 tree spp. in 1 Ha.
- Moderate stand density Station 1: 680 stems >10cm dbh in 1 Ha
- Significant species overlap between the two stations both in flora and fauna.
Discovery Tower

- 23m walk-up tower
- 12m mast
- System went on-line Dec 2008
- Remote access via LogmeIn
- A few issues to date with power supply, data storage.
Crane Tower

- Running since 2001. Due to be upgraded to the same set-up as the Discovery Tower.
- Comparable data obtained in 2009 from the two systems: Fc, H, LE.
Micromet Data

- Cape Tribulation. AWS running since Jan 2000.
- Discovery Tower. AWS running since Jan 2008.
Sub-project 2: Physiology vs Climate Change
Will Edwards (JCU)

- Grid network was established at the start of 2007

One hectare sampling grid for litter traps, soil and LAI at the Cape Tribulation Canopy Crane study site.

- Litter trap
- Crane tower

100 m
# Total Litter Fall

<table>
<thead>
<tr>
<th>Forest formation and place</th>
<th>Fine litterfall (t ha(^{-1}) year(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowland evergreen rain forest:</td>
<td></td>
</tr>
<tr>
<td>Mulu, Sarawak: ridge</td>
<td>7.7</td>
</tr>
<tr>
<td>valley alluvium</td>
<td>9.4</td>
</tr>
<tr>
<td>Pasoh, Malaya</td>
<td>10.6</td>
</tr>
<tr>
<td>Penang, Malaya</td>
<td>7.5</td>
</tr>
<tr>
<td>Manaus, Brazil</td>
<td>7.6</td>
</tr>
<tr>
<td>Lowland semi-evergreen rain forest:</td>
<td></td>
</tr>
<tr>
<td>Barro Colorado, Panama</td>
<td>13.3</td>
</tr>
<tr>
<td>Kade, Ghana</td>
<td>9.7</td>
</tr>
</tbody>
</table>

Mainly from Whitmore (1984a, Table 10.8); Anderson and Swift in Sutton et al. (1983, Table 1)  
† Heaney and Proctor (1989)

**Total Litter Fall 2007**  
12.35 tonne/ha/yr

**Total Litter Fall 2008**  
10.97 tonne/ha/yr

Woody material 35% 2007  21% 2008
Dendrometer Bands

- Dendrometer bands were placed on 170 trees with DBH >25cm March 2007
- There are differences between species in their increase in DBH
- Converted to AGB there are significant differences between families in their ability to store biomass.
- So far no indication of interannual variations related to climatic variation.
Canopy Cover

- LAI photos taken at each of litter traps to establish variations in canopy cover from the ground.
- Latest site value (2009) was 3.9
- Prof. Peter Hietz (Vienna) using photographic overlays to investigate changes in canopy cover from above the canopy.

April 2009
Trap 2
Sub-project 3: Soils vs Climate Change
Paul Nelson (JCU)

- Soil pit was installed in mid 2007
- 3 Depths 0.1m, 0.75m, 1.5m
- Sensors:
  - Temperature (thermocouple)
  - Water content (TDR probes)
  - Water potential (Gypsum blocks)
- Vacuum system
  - Used to collect water infiltrating through the profile for measuring DOC movement
Water uptake in 2008

Some rainfall data missing for Apr-May and Nov-
Water uptake depth

Wet soil: Greatest water extraction from topsoil (most negative change in water content)

Dry soil: Least water extraction from topsoil

Date Range: 8/04/2008 to 26/08/2008

Daily change in water content (m³/m³)

Soil profile water content (mm)

8/04/2008 - 26/08/2008
Water uptake from groundwater

- Installed 3 bores to measure uptake from groundwater
- Bedrock at 12-33 m depth
- Watertable at 10-13 m depth (July 2008- April 2009)
- Marc Le Blanc (JCU) is in charge of this part of the sub-project.
Sub-project 4: Phenology vs Climate Change
Caroline Gross (UNE)

SkyRail
- 5km transect using Cairns Skyrail
- Long term project: 10 years +
  initiated under MTSRF with
  co-funding from SkyRail Foundation.
- Digital images – 12 MP
- Monthly sampling
- Select species will be chosen that
  have a sensitivity to extinction &
  various breeding systems
Phenology so far (T23-24)

Jan 09
Feb 09
Mar 09
Apr 09
Digital Stitching (T7-T8)
Phenology Crane Site

- Phenological events are recorded monthly using the crane which began in Jan 2009
- Budding, flowering and fruiting events are recorded as presence or absence.
- Photography was too hard and so visual presence/absence is being used.
Aims:

- To document the temporal variability of the leaf litter inhabiting insect fauna
- To test if seasonal fluctuations are due to changes in the quantity or quality of organic input from the canopy above and/or are related to climatic fluctuations

Sub-project 5: Insect populations vs Climate Change
Nigel Stork, Peter Grimbacher (UniMelb)
Methods

- Collect insect fauna inhabiting leaf litter at the Cape Tribulation site on a monthly basis over several years

- Standardised volume (5 litres)
Numeric Results
Leaf litter beetle density over time

Density of beetles

2006 2007 2008 2009
Litter Manipulation

The amount of available leaf litter is a factor controlling beetle abundance.

- Further data collection (Leaf litter volume and quality, climatic data)
- More analyses to conduct

![Graph showing number of beetles in different conditions](image)

- **Addition**
- **Control**
- **Exclusion**

P=0.05
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