Australian Government
Department of the Environment, Water, Heritage and the Arts

Marine and Tropical Sciences Research Facility Milestone Report, March 2009

Program 5(ii): Climate Change: Rainforests and Catchments

Project 2.5ii.2: Climate change: Scaling from trees to ecosystems

Project Leader: Dr Michael Liddell, James Cook University (JCU)

Summary

The project is continuing successfully. A further two project meetings have been held to discuss the progress of the project. All objectives are moving towards their expected outcomes. A change of personnel in the research team has meant that Objective (b) will change direction somewhat in Year 4 of the MTSRF Program but for the current financial year it will maintain the same research outputs.

The outcomes from community based workshops were that more specific information about how to adapt (at an island level) would be appreciated. Clearly the need to distinguish between storm surge, sea level rise (and in some cases Tsunami) is critical, as are the connections between the direct impacts of climate change and the multiple and synergistic indirect impacts.

Agreed Project Outputs / Milestones

Targeted Activity
• Ongoing work on seasonal fluxes of carbon and water from the Daintree rainforest in relation to climatic drivers [Objective (a)];
• Preliminary findings of work on the physiological controls on rainforest tree productivity and water use efficiency [Objective (b)];
• Preliminary findings of water uptake and carbon turnover at the Australian Canopy Crane site [Objective (c)];
• Characterisation of flowering / fruiting events in phenological monitoring program [Objective (d)];
• Further findings from work on the resource related fluctuations in leaf litter insect populations on the ground and how they relate to the quality of organic input ecosystem status / productivity and climate variability [Objective (e)]; and
• Summary of any communication activities undertaken to date, including minutes of meetings / workshops if applicable.

Project Results

Description of the results achieved for this milestone

1. Progress Reports on field sampling programs

Objective (a) – Atmospheric Fluxes

Eddy covariance systems:

Discovery Tower: The Discovery Tower flux system installed at the end of 2008 is running well. Issues still need to be resolved on communications as the *Next-G* modem is unstable. Data downloaded within the last three weeks indicated no problems with the eddy covariance fluxes.

Crane Tower: The crane flux system was running fine the last time access was available to the tower – this has been limited due to availability of a qualified crane driver. This issue is now a thing of the past with the Australian Canopy Crane now having a full time certified crane driver as of mid March 2009.

Weather stations: These have been downloaded in the last month indicating substantial rain events in the 2008/2009 wet season – up to 500mm per day. The Discovery Tower system currently has a fault with the tipping bucket system and is due to be removed for repair.

Objective (b) – Plant Physiology

Monthly data collection of stomatal conductance has been ongoing. Unfortunately, the month of February was missed due to the crane operator being unavailable.

Leaf litter has been continually collected every fortnight for the past 27 months. Data from 2008 showed a similar trend to 2007, with the least amount of leaf litter occurring in July, a peak in October and then again in December. The January leaf litter for 2009 was similar to that of January 2007, both of which, however, are half that of the 2008 January average. February data for 2009 is still be sorted and weighed to see if there is a late peak in litter fall.

A fish-eye lens has been obtained for the camera purchased for the phenology project to aid in the collection of LAI data. This data is to begin quarterly collection starting from the end of March 2009 in order to cover each season. The first pictures were taken in April 2008, so this will be the first batch of yearly data.

Objective (c) – Below-ground fluxes of carbon and water

Now that over a full year of soil water content data have been collected, the full seasonal picture has emerged (Figure 1). Over the course of the dry season soil moisture was steadily depleted at all depths, with occasional rainfall not being adequate to recharge the profile. By mid December soil water content was extremely low. Water uptake (transpiration) during December was generally low, but responded rapidly to the rainfall that did occur. Soil water potential was drier than -300 kPa at all depths during most of December.

The relationship between soil water content and potential differed considerably between depths, with potential fluctuating most widely at 0.75 m depth, the depth with greatest clay content.

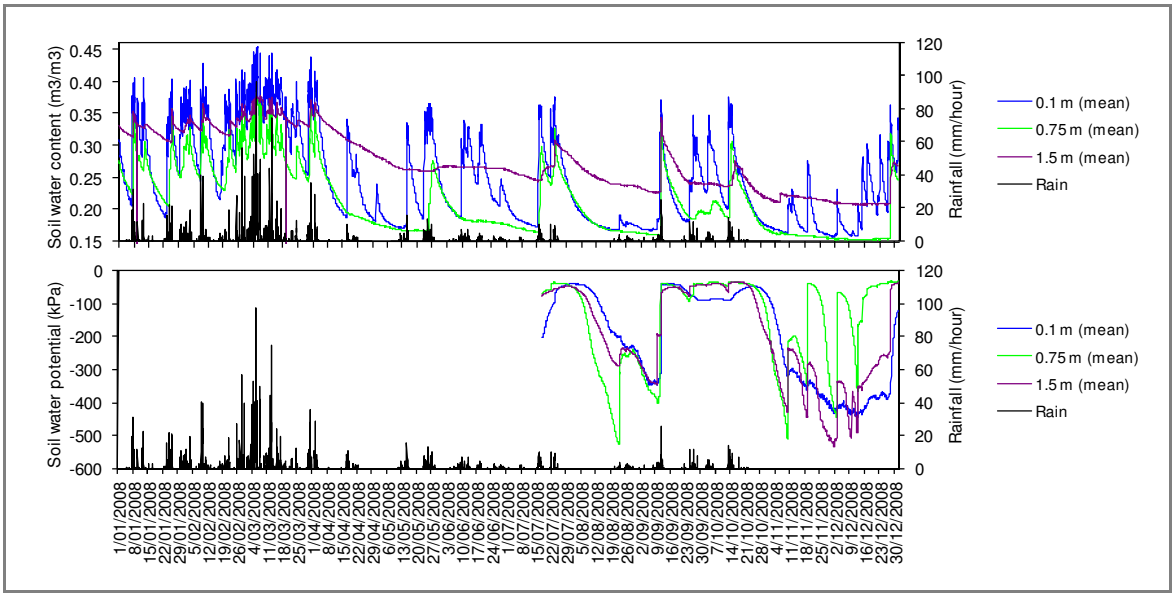

Figure 1: Soil water content (*top*), soil water potential (*bottom*) and rainfall during 2008. Some rainfall data are missing for April-May and November-December.

Objective (d) – Phenology

Sky Rail: Following the development of a standard methodology the first formal collection of photographs for identification of fruiting and flowering events began at the Skyrail site in January 2009. Image collection is occurring in the last week of every month. This time frame was selected due to extreme weather conditions early January that prevented sampling from beginning earlier. Thus, so far we have collected two months' worth of data.

The images are currently being filtered for those that contain trees which are fruiting and flowering. One third of the images from the January sampling have been passed on to Bob Jago (Cairns City Council) for identification. A brief comparison of images from January and February sampling demonstrate a good replication of photographs, making identification of the same individual tree achievable across months. We are also in the process of establishing whether GPS data linked to the photographs is accurate enough to be an additional method for individual tree identification.

Canopy Crane Site: On 27 January 2009 the phenology project also began at the Australian Canopy Crane site. Unfortunately data was not collected in February due to the unavailability of a crane driver. Data was collected on 11 March and if possible this will be repeated at the end of the month to remain consistent with the timing of sample collection at Skyrail. Currently only basic visual presence/absence of budding, flowering and fruiting is being recorded.

Digital image collection of phenology events at the canopy crane was found to be impractical. Achieving a spherical photo of the canopy within the crane plot turned out to be extremely difficult and would require a full time worker. The photographic data will therefore be collected only once a year to keep a record of canopy structure.

Objective (e) – Insect population variability

Monthly collection of beetles inhabiting the leaf litter on the ground continues.

Recent results are in agreement with data from previous years showing peaks in beetle populations around the month of January. A leaf litter manipulation experiment was completed in early February. In this complementary experiment (to the monthly collections) the amount of leaf litter within 3 x 3 meter plots were manipulated for five months to test if beetle populations respond to varying amounts of leaf litter input. In some plots leaf litter was added while in others it was excluded (using suspended bird netting). Control plots were also included (six replicates of each). In early February 2009, the experiment was completed. The leaf litter within each of the eighteen plots was collected and the invertebrates were extracted. Over three thousand beetles were tallied but the data are yet to be formally analysed. Before all leaf litter was collected, soil gas and soil core samples [Objective (c)] were taken for analysis.

2. Communications, major activities or events

During milestone reporting period

Project meetings were convened on 29/01/09 and 12/03/09.

Minutes are attached as Appendix 1.

During next milestone reporting period

A further project meeting is scheduled for mid May.

Will Edwards to prepare a plan of new research activities of Objective (b) under Year 4 of the MTSRF in the near future.

Appendix 1

Minutes of Project 2.5ii.2 Group Meeting

2:30pm, 29 January 2009

Project 2.5ii.2: Climate change: Scaling from trees to ecosystems

Attendance: Michael Liddell, Paul Nelson, Cassandra Nichols, Peter Grimbacher.
Location: Liddell office (E1.112), James Cook University, Cairns.
Apologies: Peter Franks

Objective (a) – Atmospheric Fluxes

Michael Liddell briefed those present on the status of the flux sub-project. The Australian Canopy Crane system has electronic components which are aging and the data logging system will be replaced in the near future. The system experienced a two-week failure in December and is now operational again. The new Daintree Discovery Tower system went operational on 22 December 2008 and has mobile connectivity. This has indicated that it has been working successfully when the weather has been conducive to flux measurements.

Objective (b) – Plant Physiology

Cassandra Nichols indicated that the leaf litter work was continuing as usual. Peter Grimbacher to update the group when he is back from overseas on the isotope work on the litter samples.

Objective (c) – Soil structure / hydrology

Paul Nelson informed the group that the soil moisture/temperature pit was working normally. Soil water samples had been collected and were being bulked up prior to analysis. Sarah Connor had visited the site and collected gas samples for subsequent N_2O, CH_4, CO_2 analysis on Peter Grimbacher's litter control plots. In addition Sarah had collected samples for analysis of mineral NO_3^-, NH_4^+ and bulk density. Data from the bores is to be downloaded from the loggers by Marc Le Blanc in the near future.

Objective (d) – Flowering / fruiting phenology

Cassandra Nichols explained that the Skryail work was proceeding well and two months' worth of data had been collected. Michael Liddell had established connections with Cairns Council and Bob Jago had a Memorandum of Understanding in front of Council for evaluation at the moment. A protocol was being trialled for Cassandra to sort images for Bob Jago to subsequently identify. Trials at the crane plot had been carried out using visual presence/absence surveys but these appeared quite time intensive. Peter Hietz was working on the photographic approach in parallel.

Objective (e) – Resource related fluctuations in insect populations.

Peter Grimbacher indicated he was attending his last project meeting before moving to Melbourne to take up a new post-doc position with Nigel Stork. The team wished him well.

Peter explained that he was taking down the litter control experimental plots in the next week. Michael Liddell explained that plans were in place to keep the monthly leaf litter work going when Peter was in Melbourne.

Other Business

Some discussion commenced on how the sub-projects would tie up at the end of the fourth year of the MTSRF Program. Agreed that Michael Liddell would circulate the original agreed and contracted milestones to the group to refresh them on what was involved. Cassandra briefed the group on recent developments at the crane site with the road, power supply and new accommodation quarters, and the passing of a Queensland Workplace Health and Safety audit.

The next meeting was scheduled for around 10 March 2009.

Minutes of Project 2.5ii.2 Group Meeting

9:30am, 12 March 2009

Project 2.5ii.2: Climate change: Scaling from trees to ecosystems

Attendance: Michael Liddell, Cassandra Nichols, Will Edwards, Carl Wardhaugh. Caroline Gross on teleconference from UNE.
Location: Liddell office (E1.112), Cairns.
Apologies: Paul Nelson, Peter Franks, Peter Grimbacher.

Michael Liddell briefed the group on the recent changes to the group structure. Peter Franks had resigned from James Cook University (JCU) to take up a position at Sheffield, effective immediately.

Will Edwards (also JCU) had been asked to take over the leadership of the sub-project and Peter will maintain a role as adjunct from the UK.

Objective (a) – Atmospheric Fluxes

Michael Liddell briefed those present on the status of the flux sub-project. The new Daintree Discovery Tower system is operating reliably. The Canopy Crane system has not been able to be accessed since the last meeting due to restrictions on availability of access to the tower. In mid-March this problem will be solved when the facility will have its own fully trained and certified driver, Andrew Thomas, who is already working part-time on the project.

Objective (b) – Plant Physiology

Cassandra Nichols indicated that the leaf litter work had now completed two years of collection. The porometer measurements had suffered the same problems at the flux system where limited access had meant the loss of two months' of data. Again this problem will be a thing of the past from mid-March.

Objective (c) – Soil structure / hydrology

Cassandra Nichols informed the group that the soil moisture/temperature pit was working normally. Data from the bores is to be downloaded from the loggers by Marc Le Blanc and his student in mid-March.

Objective (d) – Flowering / fruiting phenology

Cassandra Nichols explained that the Skyrail work was proceeding well and three months' worth of data had been collected. Bob Jago was working on identifying a set of photos collected and sorted into those with flowers/fruit by Cassandra. Caroline Gross indicated even partially identified photos would be useful so that she could get started on the

phonological work. Caroline indicated that she would like to visit 7-12 June to inspect how the data was being collected. Michael Liddell to find out how the Memorandum of Understanding had progressed with the Council.

Objective (e) – Resource related fluctuations in insect populations.

Carl Wardhaugh explained that he had only two more months' of data collection and then his sampling for his PhD was complete – at present he has collected 32,000 insects.

Other Business

Cassandra briefed the group on recent developments at the crane site with the road, power supply and new accommodation quarters. A meeting was to be held immediately after this meeting regarding the proposed second round of the MTSRF (2010 onwards) and so this meeting adjourned to move to the larger group meeting in room B1.102 at 10:00am (Michael Bird, Marc Le Blanc, Peter Grimbacher, Will Edwards, Cassandra Nichols, Carl Wardhaugh, Caroline Gross, Andrew Krockenberger, Mike Liddell).

The next meeting was scheduled for around 15 May 2009.