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

Marine and Tropical Sciences Research Facility (MTSRF)
June 2008 Milestone Report

Project 4.9.3 – Impacts of urbanization on North Queensland environments: management and remediation

Project Leader: **Prof Stephen Turton**
James Cook University

Summary

The project has been making steady progress. Dr Miriam Goosem was employed as Research Fellow for three years, whilst Dr Catherine Pohlman has a post-doctoral fellowship for 18 months using both MTSRF and Powerlink funds. Seven research officers, Dr Robyn Wilson, Mr Gregory Dawe, Dr Conrad Hoskin, Mr Les Searle, Ms Tina Lawson, Ms Susan Walker and Dr Martin Cohen have also been employed on the project at various times during the year using a combination of Queensland Department of Main Roads, Powerlink and JCU internal research grant funding. JCU and CSIRO have provided funds for a PhD student scholarship and research funds to consider social aspects of the sea- and tree-change phenomenon in far north Queensland.

Powerlink and MTSRF funds have been utilised to finalise the project, report and journal article regarding cyclone impacts on microclimate and vegetation adjacent to the Palmerston Highway and power line clearing west of Innisfail. Data collection concerning edge effects adjacent to power line clearings in savannah habitats will continue throughout 2007, with wet season data collection complete. Remote sensing data analysis and reporting of cyclone damage and its relation to linear infrastructure through wind throw and tree fall is expected to be completed in August, 2007. A series of Queensland Department of Main Roads reports have been completed with two in draft form. Data analysis regarding traffic noise impacts on frogs is underway, while monitoring of Palmerston highway overpasses will continue for several months using QDMR funding. Journal articles concerning traffic noise penetration and vegetation quality and habitat connectivity of riparian areas in Douglas Shire are in press. Another regarding overpasses is in revision. Movement and home ranges of possums is under assessment near the Kennedy Highway for comparisons with the cyclone-affected area of the Palmerston Highway.

Methodology for use in the riparian and remnant quality and connectivity project has been evaluated, considering vegetation quality assessment from a variety of sources. Available remote sensing data and other available information is currently being assessed regarding several areas under consideration as sites for remote sensing evaluation, GIS modelling and field sampling. Final site locations are to be considered at a stakeholder workshop in August. A PhD student, Ms Pam Schulz, has been appointed to examine social aspects of the sea and tree-change phenomenon in far north Queensland, commencing in July. The current working title of her thesis is ‘Defining social thresholds for living in tropical landscapes’.

Milestone extracted from Project Schedule

Report 3 Submission

- Final report on selection of riparian vegetation assessment area(s) and findings of the desktop analysis on remote sensing imagery and GIS interpretation (obj b, dependent on a student)
- 3 Wet Tropics book chapters:
  (1) Rethinking Road Ecology (obj a)
  (2) Fragmentation effects in rainforests (obj a)
  (3) Application of remote sensing in rainforest conservation and management (obj b)
- Final summary of communication activities taken through the course of Year 1 of the project.
- Plan for completion of out year activities.
- Final report on the Powerlink projects (obj a, Tasks noted as ##: indicators of infrastructure impacts; use of remote sensing data to assess habitat condition adjacent to infrastructure).
- Information Transfer between agencies
- Provision of Project 4.9.3 data to Powerlink on Cyclone Larry impacts research and savanna microclimate and vegetation edge effects and impacts. Responsible Officer: Dr Miriam Goosem (JCU).
- Provision of Project 4.9.3 data to QDMR on linear infrastructure mitigation in the wet Tropics region. Responsible Officer: Dr Miriam Goosem (JCU).

Project Results

1. Report on selection of riparian vegetation assessment area(s) and findings of the desktop analysis on remote sensing imagery and GIS interpretation

Although the PhD student evincing interest in this project has since changed direction, initial desktop evaluation of available remotely sensed imagery and documentation has occurred prior to a stakeholder workshop in July/August 2007. The workshop will be presented with current information on five alternative sites which have been suggested from a variety of sources including the MTSRF Board. The workshop aims to finalise two or three sea- and/or tree-change landscapes from the five alternatives. These will then be the subject of remote sensing analysis and GIS modelling and field sampling. Evaluation of potential field vegetation analysis parameters has also been undertaken. A simplified version of the toolkit prepared in Project 4.9.6 is currently proposed for rapid field sampling, while habitat connectivity will be examined in the field using faunal indicator observations. See Appendix 1.

2. Three Wet Tropics book chapters:

These three chapters (see Appendix 2) are in press with Blackwell Publishers to be published in the book:

Living in a Dynamic Tropical Forest Landscape Edited by: Nigel Stork and Steve Turton (James Cook University) The book is currently scheduled for release in December 2007.

Blackwell Publisher''s Description: The book brings together a wealth of scientific findings and ecological knowledge to survey what we have learned about the "Wet Tropics" rainforests of North Queensland, Australia. This interdisciplinary text is the first book to provide such a holistic view of any tropical forest environment, including the social and economic dimensions.

- The most thorough assessment of a tropical forest landscape to date
- Explores significant scientific breakthroughs in areas including conservation genetics, vegetation modeling, agroforestry and revegetation techniques, biodiversity assessment and modeling, impacts of climate change, and the integration of science in natural resource management
- Research achieved, in part, due to the Cooperative Research Centre for Tropical Rainforest Ecology and Management (the Rainforest CRC)
- Written by a number of distinguished international experts
- Contains chapter summaries and section commentaries.

3. Report on the remaining Powerlink projects.

a) Examination of the use of high-resolution remotely sensed data to assess habitat condition adjacent to linear community infrastructure

The project assesses "*Cyclonic Disturbance along Palmerston Powerline Clearing Edges'*. IKONOS satellite data prior to and post-cyclone Larry has been rectified and/or registered to aerial photography. Difference imaging in a number of spectral bands is currently underway to examine changes in vegetation since the cyclone. Remotely sensed data classification is being informed by detailed post-cyclone vegetation damage data acquired at previously studied sites (Pohlman *et al*., submitted). The treefall direction and extent of disturbance data currently being compiled from aerial photography for 100m x 100m distances every 500m along the anthropogenic and natural clearings (see Appendix 3a) is also applied to the classification. Patterns of vigorous growth detectable in the difference images in cyclone-damaged areas will be compared with damage seen in aerial photography and growth at known sites in terms of type of recovery. Analysis will consider any effect of distance from clearings on extent and pattern of damage.

b) Edge effects of powerline clearings on microclimate and vegetation in tropical savanna ecosystems

Data collection and analysis is underway for the Powerlink project examining *'Powerline Clearing Impacts in Dry Sclerophyll Woodland of the Wet Tropics Bioregion'*. For full progress report see Appendix 3b. Microclimate and vegetation transects in savanna woodland habitats near Davies Creek adjacent to the Chalumbin-Woree powerline clearing have been established perpendicular and parallel to the powerline clearing. Transects occur on either side of the clearing at three sites.

Vegetation, litterfall and microclimate datasets are complete for the wet season with tree and shrub surveys and treefall surveys almost complete and soil seed bank samples being monitored. Powerlink requested that the study be extended to incorporate two further transect assessments and this extra work has been incorporated with budgets developed and a variation to the Powerlink contract proposed.

4. Update on activities associated with Objective a: Linear community infrastructure: impacts and mitigation

This section of the project is to be reduced in scope in 2007/2008 to allow increased effort to be placed on Objectives b) and c). However several smaller projects funded by Queensland Department of Main Roads and Powerlink will continue, using personnel employed on these external funds. Dependent on funding QDMR projects to continue include Mission Beach roads and cassowaries project, monitoring of Palmerston canopy bridges and monitoring of East Evelyn underpasses and finalisation of best practice manual. Powerlink projects to continue include the completion of the savanna edge effects assessment and the finalisation of the remotely sensed cyclone disturbance project.

a) Refinement of best practice designs to maximise ecological connectivity and minimise impacts of linear community infrastructure in rainforest and adjoining habitats of the Wet Tropics WHA (QDMR Best-Practice Manual)

The Queensland Department of Main Roads Best Practice Manual entitled 'Roads in Tropical Forest, Best Practice Guidelines: Planning, Design and Management' by Chester, Goosem, Cowan, Harriss and Tucker, was submitted to QDMR Environment Branch in Brisbane in May 2006. It was subsequently evaluated by QDMR Environment branch and environmental and operation staff throughout Queensland which resulted in the decision to divide the document into two sections comprising a short set of guidelines for operational staff and a larger reference document. The managing scientist provided a suggested format for the guidelines document in March after discussions at our large roads and environmental manager's seminar in January. QDMR have since agreed to the employment of Dr Elaine Harding to undertake the review of comments and rewriting of the documents between July and October 2007. A collaborative meeting with QDMR personnel to discuss the documents is currently scheduled for early July 2007.

b) Preliminary identification of informative and cost-effective ecological indicators of linear infrastructure impacts in rainforests and adjoining habitats in the Wet Tropics bioregion.

Addressing this research objective has been made possible with funding from MTSRF, Powerlink and the Queensland Department of Main Road (QDMR). These varied types of data are under consideration as cost-effective indicators of linear infrastructure impacts in rainforests and adjoining habitats.

MTSRF-funded components

Microclimate and vegetation data collection in savanna woodland habitats at Davies Creek adjacent to the Chalumbin-Woree powerline clearing has continued for a Powerlink and MTSRF funded project, which will be completed in March 2008. Editing of final Queensland Department of Main Roads reports has continued.

Powerlink-funded components

Data collection has commenced for the Powerlink project examining *'Powerline Clearing Impacts in Dry Sclerophyll Woodland of the Wet Tropics Bioregion'*. Datasets of vegetation and microclimate in the wet season are complete with early dry season data collection to commence in July (see 3 b) above). The project '*The Effects of Severe Tropical Cyclone Larry on Rainforest Vegetation and Understorey Microclimate Adjacent to Powerlines, Highways and Streams'* which examined previously surveyed sites is complete (see attached Executive Summary and Abstract of journal article). Remote sensing evaluation of damage near linear clearings at a wider scale is underway (see 3a) above).

QDMR-funded components

Research regarding these components in 2006/07 has involved the completion of reports and revision of drafts regarding the impact of headlights, streetlights and traffic noise into the rainforest habitats near or adjacent to the Kuranda Range section of the Kennedy Highway. Data concerning the penetration of nocturnal traffic noise into rainforest habitats along the major creeks in the area were collected in late 2006, and a report prepared regarding the analysis, a draft of which is currently being evaluated by QDMR. Nocturnal surveys of amphibians and recording of calls was completed in February 2007 with data currently in analysis phase. The final combined report is being prepared.

c) Preliminary consideration of effectiveness of mitigation strategies in restoring ecological processes and function in the vicinity of linear community infrastructure

We were unable to secure an APA-funded student or alternative funding for a postgraduate student for this activity. We are currently approaching overseas and Australian students with stipends whenever the opportunity arises. Ringtail possum home range information in the vicinity of overpasses currently being compiled (see (e) below), together with overpass monitoring data, provides an indication of student project viability. This data suggests that underpasses and adjacent terrestrial fauna populations and underpass use should form the initial focus for a student project that considers ecological processes.

A minor Masters of Applied Science student project to examine effectiveness of fences in preventing small mammals reaching the road surface and thus becoming potential road victims commenced in February 2007 and has tested a range of fence designs. This project should be completed and report prepared in July 2007.

d) Examination of the use of high-resolution remotely sensed data to assess habitat condition adjacent to linear community infrastructure

IKONOS satellite data prior to and post-cyclone Larry has been rectified and/or registered to aerial photography for the Powerlink project assessing "*Cyclonic Disturbance along Palmerston Powerline Clearing Edges'*. Difference imaging in a number of spectral bands is currently underway to examine changes in vegetation since the cyclone. Remotely sensed data classification is being informed by detailed post-cyclone vegetation damage data acquired at previously studied sites (Pohlman *et al*., submitted) and the treefall direction and extent of disturbance data currently being compiled from aerial photography for 100m x 100m distances every 500m along the anthropogenic and natural clearings. Patterns of vigorous growth detectable in the difference images in cyclone-damaged areas will be compared with damage seen in aerial photography and growth at known sites in terms of type of recovery. Analysis will consider any effect of distance from clearings on extent and pattern of damage.

e) Ongoing monitoring of the effectiveness of mitigation strategies in reducing impacts of linear infrastructure on threatened, rare and endemic species.

Monitoring of canopy bridges above the Palmerston highway has continued using both remote camera and observational techniques. Information regarding this monitoring was presented at the QDMR seminar in January, 2007 and in progress reports due in March and June 2007. Rare possum populations including those of the Lemuroid Ringtail, Herbert River Ringtail and Green Ringtail have been monitored adjacent to the structures and a report concerning home ranges of Lemuroids and Herbert River ringtails is being compiled. At least one Herbert River ringtail and one Green Ringtail have crossed the bridge on several occasions. Problems with remote camera electronics have been resolved. Observational monitoring has not recorded canopy bridge use. Underpass effectiveness at East Evelyn for tree kangaroos and cassowaries has not been monitored this year while waiting for QDMR to undertake maintenance of the underpasses.

5. Summary of communication activities undertaken to date, including minutes of meetings, workshops if applicable.

a) A series of desk and field workshops with Powerlink personnel have occurred throughout 2006/2007 to agree on projects, sign contract, choose field sites for savanna project, examine field sites for cyclone impact on microclimate and vegetation, provide progress updates and undertake field work.

Meetings and field workshops and field work with Powerlink personnel were held on:

- 6 July, 2006; meeting
- 7 July, 2006; field workshop
- 12 October, 2006; meeting
- 13 October, 2006; field workshop
- 12 November, 2006; field workshop
- 19 January, 2007 – 23 January, 2007; field work
- 26 January, 2007; meeting.
- Progress updates have also been provided to Powerlink personnel via email every 2-3 weeks.

b) A large seminar was held on 30 January, 2007 at Crowther Lecture theatre, JCU Cairns campus to report on Queensland Department of Main Roads projects. The seminar was attended by 30 personnel from agencies including QDMR Environment Branch in Brisbane, QDMR Peninsula district, Environment Protection Agency from Cairns and the Atherton Tablelands, Wet Tropics Management Authority, and James Cook University project researchers. The seminar was well-received. Post-seminar discussions were held regarding Best Practice guidelines document and impact research reports.

c) Several meetings have occurred between JCU researchers and QDMR personnel and consultants, which, together with regular email and phone updates keeps collaborators informed of project progress. These informal contacts are also used to provide environmental advice from researchers to DMR regarding various projects including those concerning the Kuranda Range upgrade, East Evelyn underpasses, Mission Beach underpasses and Best Practice guidelines.

d) At a meeting in May 2007, Brisbane Queensland Department of Main Roads requested copies of all reports and a summary of funding supplied to James Cook University researchers over the past 6 years. These have been collated.

e) Email and phone contacts have enabled the project to liaise with QDMR Brisbane regarding the Best Practice Guidelines document which now will have comments addressed and the document will be restructured between July and October 2007.

f) A meeting with Project 4.9.6 (Dr Rosemary Hill), Dr Alan Dale of FNQNRM Ltd and Dr Miriam Goosem has agreed a strategy whereby Project 4.9.3 will have input regarding the environmental impact of roads into the Mission Beach Habitat Network Action Planning process currently underway. Subsequent attendance by Miriam Goosem at the Project 4.9.6 action workshop on 31 May has facilitated this collaboration.

g) Dr Miriam Goosem and Dr Catherine Pohlman attended the Association for Tropical Biology and Conservation Asian Chapter conference in Mahabalipuram, India, from 5-10 March, where they presented the following papers:

Goosem, M. (2007). Can rainforest roads contribute to loss of biodiversity? *Association of Tropical Biology and Conservation Tropical Biology Asian Chapter Conference,* Mahabalipuram, India, March 2006.

Pohlman, C., Goosem, M. and Turton, S. (2007). Is cyclone damage greater near the edges of roads, powerlines and streams than in the interior of tropical rainforest? *Association of Tropical Biology and Conservation Tropical Biology Asian Chapter Conference,* Mahabalipuram, India, March 2006.

h) Dr Miriam Goosem was invited to form part of an expert panel at a Department of Environment and Water Resources workshop in Canberra in early May, 2007. The panel concerned mitigation measures used to deal with the issue of habitat fragmentation by major linear infrastructure and evaluated an experts' report.

i) Dr Catherine Pohlman will attend the Queensland Rainforest Forum: Recovering Rainforest in late June 2007 in Brisbane to present a paper:

Pohlman, C. (2007). Internal fragmentation in the rainforest: the effects of clearings for highways and powerlines on tropical rainforest plant communities.

While in Brisbane she will also present the cyclone damage paper shown at g) above to a purposely-organised Powerlink seminar.

j) Several journal articles have been submitted, with some revised and resubmitted or published in the past year (abstracts attached, Appendix 5). These include:

Dawe, G. and Goosem, M. (2007). Vehicle noise attenuation through tropical rainforest at ground and lower canopy levels: distance penetrated by noise disturbance. *Journal of Environmental Management*, in press.

Lawson, T., Gillieson, D. and Goosem, M. (2007). Assessment of riparian rainforest vegetation change in tropical north Queensland for management and restoration purposes. *Geographical Research*, in press.

Lawson, T., Goosem, M. and Gillieson, D. (2007). Rapid assessment of habitat quality in riparian rainforest vegetation. *Pacific Conservation Biology,* in press.

Pohlman, C., Turton, S. and Goosem, M (2007). Edge Effects of Linear Canopy Openings on Tropical Rainforest Understorey Microclimate. *Biotropica* 39, 62-71.

Pohlman, C., Goosem, M. and Turton, S. (submitted). Effects of severe tropical cyclone Larry on rainforest vegetation and understorey microclimate near roads, powerlines and streams. *Austral Ecology*.

6. Plan for completion of out year activities

Task	Objective / Deliverable	Date / Timing
(a)	Informative and cost-effective ecological indicators of linear infrastructure impacts in rainforests and adjoining Wet Tropics habitats, dependent on funding from Powerlink and/or QDMR.	Jun 2010
	Analysis of effectiveness of mitigation strategies for linear infrastructure impacts for restoring ecological processes and reducing impacts on rare or threatened species, dependent on funding (Powerlink and/or QDMR).	Jun 2010
(b)	Completion of analysis of habitat quality using easily assessed indicators from remote sensing and GIS for second site agreed by stakeholders*.	Jun 2009
	Identification of priority areas for restoration for enhancement of landscape connectivity for second site agreed by stakeholders*.	Jun 2009
	Completion of analysis of habitat quality using easily assessed indicators from remote sensing and GIS for all sites agreed by stakeholders*.	Jun 2010
	Identification of priority areas for restoration for enhancement of landscape connectivity for the chosen regions*.	Jun 2010
(c)**	Literature review of the phenomena of sea- and tree-change in Australia.	Dec 2008
	Historical analyses of land use change and urbanisation patterns in the case study areas.	Jun 2009
	Assessment of landscape values in sea- and tree-change landscapes.	Jun 2010
	Assessment of the impacts of urbanisation on sea- and tree-change landscapes.	Jun 2010
	Practical recommendations for local government and NRM authorities on managing and remediating impacts of urbanisation	Jun 2010

* The number and location of sites for assessment under objective (b) will be considered in the late July/early August stakeholder workshop. Due consideration must be given to financial constraints which suggest that only two or possibly three area assessments are achievable.
** Further social assessment under objective (c) is still under consideration with respect to budget available.

7. Information transfer between agencies:

a) Provision of Project 4.9.3 data to Powerlink of Cyclone Larry impacts research and savanna microclimate and vegetation edge effects and impacts. Responsible Officer: Dr Miriam Goosem (JCU).

   The final report entitled: '*The Effects of Severe Tropical Cyclone Larry on Rainforest Vegetation and Understorey Microclimate Adjacent to Powerlines, Highways and Streams'* by Pohlman, C. and Goosem, M. (2007) was finalised and final copies provided to Powerlink in March.

   Progress reports regarding: *Powerline Clearing Impacts in Dry Sclerophyll Woodland of the Wet Tropics Bioregion* "*Cyclonic Disturbance along Palmerston Powerline Clearing Edges*. was provided to Powerlink in May 2007 through RRRC and another will be provided in June 2007.

   Regular progress updates via workshops, field excursions, meetings, email and phone have been provided.

b) Provision of Project 4.9.3 data to QDMR on linear infrastructure mitigation in the wet tropics region. Responsible Officer: Dr Miriam Goosem (JCU).

The final report entitled:*'Noise Disturbance along Highways: Kuranda Range Upgrade Project'*by Dawe, G. and Goosem, M. (2007a) was finalised and final copies provided to QDMR in June 2007.

The final report entitled:'*Vehicle Headlight and Streetlight Disturbance to Wildlife: Kuranda Range Upgrade Project'*by Wilson, R. and Goosem, M. (2007) was finalised and final copies provided to QDMR in June 2007.

The draft report entitled:'*Nocturnal Noise: Kuranda Range Upgrade Project"*by Dawe, G. and Goosem, M. (2007b) was submitted for comment to QDMR in June 2007.The progress report:' *Overpass monitoring and frog surveys: Kuranda Range Upgrade Project'*by Goosem, M., Cohen, M. and Hoskin, C. was provided to QDMR in May 2007.Regular progress updates via seminar, email and phone have been provided to QDMR personnel.

Explanation of Activity changes

Two changes in activity planning, personnel and execution have occurred within the project recently.

Firstly, a workshop to decide on sea and/or tree-change landscapes in which to undertake the riparian and remnant vegetation and connectivity assessment will be scheduled for late July or August 2007, as further collaboration is required.

Secondly, GIS expert Ms Tina Lawson left this project for a CSIRO project in April 2007. This necessitated employment of Ms Susan Walker to undertake aerial photograph analysis of treefall and Mr Les Searle to undertake satellite imagery analysis for the Powerlink remote sensing project on cyclonic disturbance. Several weeks passed while waiting for Mr Searle to become available. Rapid progress has been made since Mr Searle commenced in June and the August target for reporting appears achievable.

Mr Searle will also be available to commence riparian and remnant vegetation analysis in July.

Project is on track.

Problems and opportunities

Opportunities for continuing research concerning cyclone impacts with respect to linear infrastructure have arisen through funding from Queensland Department of Main Roads, Powerlink and JCU internal research grants.

No technical problems encountered, other than loss of staff and several weeks delay in re-employment of suitable personnel. Problem now resolved.

Communications, major activities or events

During next milestone reporting period

Release of the book with the three book chapters should occur is scheduled for December 2007.

A stakeholder workshop will be organized for late July/early August to finalise landscapes for remnant and riparian vegetation quality and habitat connectivity assessments and social impacts research.

Further progress contacts via email, phone and impromptu meetings are expected with DMR and Powerlink personnel.

Forecast variations to planned milestones

Although funding for the Powerlink project *2. Powerline clearing edge impacts in dry sclerophyll woodlands* will be received by 30 June 2007, data collection will not be complete until the end of January, 2008, and the final report is therefore expected to be presented to Powerlink in March, 2008. Powerlink has been informed of the alteration to the milestones due to late contract signing and thus later commencement of field work than initially expected. Powerlink has agreed to fund the extra work with regards this project, occasioned by the increase in transects from 4 to 6.

Powerlink has also agreed that the report for the remote sensing project regarding cyclonic disturbance will be received by Powerlink in August 2008.

Appendix 1

Report on selection of riparian vegetation assessment area(s) and findings of the desktop analysis on remote sensing imagery and GIS interpretation (obj b, dependent on a student)

a. Although the postgraduate student did not commence objective b) of Project 4.9.3 in 2006/07, sections of this project have been undertaken in preparation for project continuation in 2007/2008.

b. Five sea or tree-change landscapes within the Wet Tropics bioregion have been suggested as suitable areas for rapid assessment of riparian and remnant vegetation quality and habitat connectivity. All of these are currently undergoing urbanisation or rural subdivision or are proposed for future population growth. A collaborative workshop of stakeholders from management agencies and natural resource bodies is proposed for late July/early August 2007 to allow final selection of 2 or 3 landscapes for remote sensing assessment, GIS modelling and field sampling of vegetation quality and habitat connectivity. The aim will be to align areas, wherever possible, with the social component being undertaken in objective c).

c. The final desktop analysis of remotely sensed imagery and GIS interpretation available for the areas chosen will be undertaken after the site selection workshop, although initial assessments of available imagery have occurred for some potential areas as follows:

a) In any cyclone-affected landscapes selected by the workshop, the aerial photography flown since Cyclone Larry is likely to form the basis of assessments, as these will provide the most recent remotely sensed data with the potential to adequately indicate habitat quality and connectivity in these landscapes. Habitat quality and connectivity within these landscapes has been compromised by cyclone damage and subsequent weed ingress and any prioritisation of areas for small-scale restoration needs to incorporate these larger-scale impacts. Recent satellite imagery is also available to supplement the aerial photography at a wider scale. However, post-cyclone satellite imagery already available includes cloud over some areas of the images, causing difficulties in analysis.

Experience of remote sensing and GIS analysis of cyclone-affected landscapes has been gained over the past year during the analysis of cyclone impacts adjacent to powerline clearings undertaken in Project 4.9.3 objective a) as a Powerlink-funded project and during examination of Cyclone Larry impacts over wider areas for TLJV cyclone projects. This knowledge will be invaluable when applied to selected tree- and sea-change landscapes that are similarly affected. The relevant techniques used in these 2006/07 projects include analysis of aerial photography to analyse treefall extent and direction in combination with analysis of IKONOS satellite imagery to create difference images pre- and post-cyclone which can demonstrate where vegetation growth is occurring. Field verification of the remotely sensed imagery in the cyclone projects has been undertaken using a modified version of the revised restoration toolkit developed by Kanowski and Catterall (2007) in Project 4.9.6 and during Rainforest CRC restoration projects.

Final vegetation quality analysis will use a reduced version of this toolkit evaluated and contrasted with the very simple proforma used by Lawson *et al.* (2007a) to create a rapid assessment technique that provides adequate baseline data for later monitoring. Cyclone project evaluations have demonstrated that the current restoration toolkit format may be more complex than required for this project's vegetation field

assessment, which relies on rapid assessment of a large number of sites to examine the consistency of conclusions drawn from remotely sensed data. However, use of elements of the toolkit will provide greater data depth than that used by Lawson *et al.* (2007a) and yet allow a relatively large number of sites to be evaluated in a timely fashion. Experience gained by Pohlman *et al*. (submitted) in fine-scale evaluation of cyclone damage at sites surveyed prior to and post cyclone will also inform this evaluation in terms of damage categories. A stereo photographic technique used by Mr Les Searle for photo point monitoring of savanna landscapes will also be evaluated for use within rainforest areas in this revised methodology. If possible within weather constraints, red:far red ratios will provide information with respect to canopy cover and light availability (Pohlman 2006) to combine with densitometer measurements.

b) In several of the less cyclone-affected areas under consideration during the workshop, remotely sensed imagery which has been used for previous indications of remnant and riparian vegetation may need to be updated using more recent imagery. This will allow analysis of current clearing and/or regrowth patterns. The current project can build upon these earlier data in terms of vegetation and habitat quality using the methodology developed by Lawson *et al*. (2007b), without undertaking the detailed assessment of regional ecosystems and/or management planning that is available from other sources. Sites for field assessment in a variety of canopy cover and riparian width/remnant area classes can then be chosen for further vegetation quality and faunal connectivity analyses. The modified toolkit approach should be equally applicable in these landscapes, together with appropriate and easily-assessed faunal indicators of habitat quality.

References:

Kanowski, J. and Catterall, C. P. (2007). Monitoring Revegetation Projects for Biodiversity in Rainforest Landscapes. Toolkit Version1, Revision 1. Marine and Tropical Sciences Research Facility, Cairns. 52pp.

Lawson, T., Goosem, M. and Gillieson, D. (2007a). Rapid assessment of habitat quality in riparian rainforest vegetation. *Pacific Conservation Biology*, in press.
Lawson, T., Gillieson, D. and Goosem, M. (2007b). Assessment of riparian rainforest vegetation change in tropical north Queensland for management and restoration purposes. Geographical Research, in press.

Pohlman, C. (2006). Internal fragmentation in the rainforest: edge effects of highways, powerlines and watercourses on tropical rainforest understorey microclimate, vegetation structure and composition, physical disturbance and seedling regeneration. Unpublished PhD thesis, James Cook University.

Pohlman, C., Goosem, M. and Turton, S. (submitted). Effects of Severe Tropical Cyclone Larry on rainforest vegetation and understorey microclimate near roads, powerlines and streams. *Austral Ecology*.

Appendix 2

Three Wet Tropics book chapters.

Appendix 3a

Progress report: Part 1 of Cyclone Disturbance Project
Airphoto Analysis for Tree Damage Direction and Extent due to Cyclonic Winds

1. Progress on aerial photography analysis progress:

Areas analysed:

- Powerline clearing: At spacings of 500 m along each side of the clearing squares of 100 x 100 m have been analysed for treefall direction and extent. Perpendicular to the clearing these 1 hectare areas extend continuously to 500 m inside the interior of the forest.
- Highway 100 x 100m x 5, on either side every 500m
- Creek 1 100m buffer x 5
- Creek 2 100m buffer x 5
- For data comparison - study sites from Pohlman *et al*. (2007): 100m buffer

2. Highway and Powerline clearing

The powerline clearing and the highway have been approached in the same way, by creating five sample areas of 10,000 m^2 extending from either side of the clearing, every 500m along the corridor (Figure 3a.1).

Figure 3a.1. Highway and powerline clearing sample areas

The extent of the analysis for the powerline clearing and the highway are shown in Figure 2. Table 1 lists the coordinates for the areas.

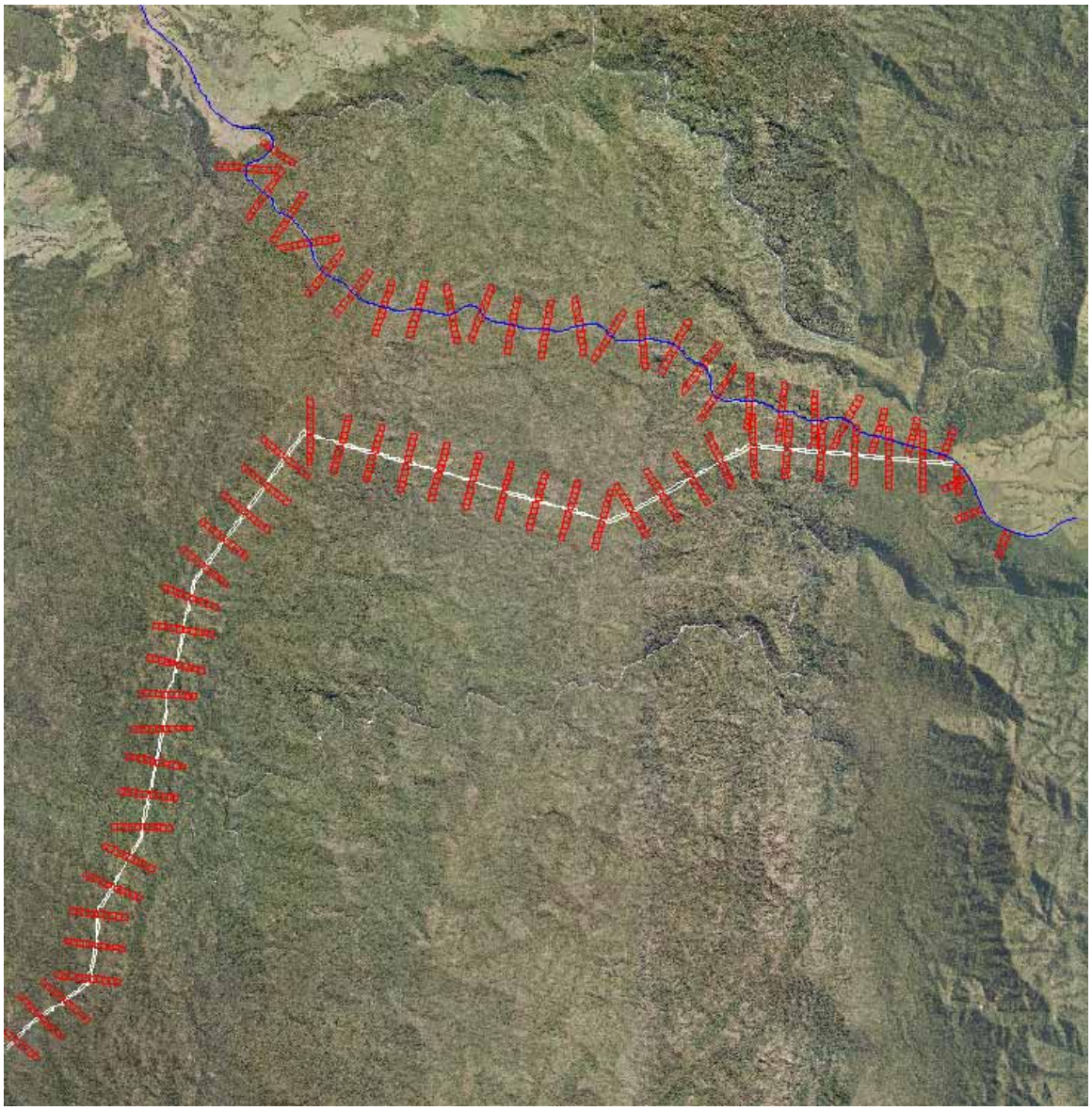


Figure 3a.2. Extent of study analysis.
Note: Powerline clearing shown in white and highway in blue.

Powerline		
Start	373547.90	8050897.09
Finish	360319.46	8057892.57
Highway		
Start	372629.67	8052068.20
Finish	356063.86	8041855.38

Table 3a.1. Highway and Powerline clearing coordinates (GDA 1994 MGA Zone 55)

3. Waterway canopy openings

Two creeks have initially been identified for analysis, Henrietta Creek (marked on Figure 3a.3 as Beatrice River) and Douglas Creek. Time permitting; further analysis of waterways, including the South and North Johnstone and Beatrice River will be performed.

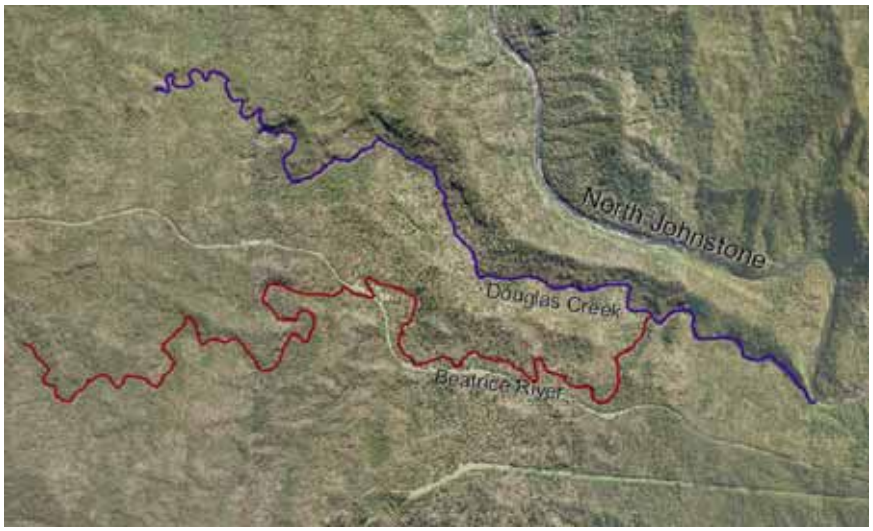


Figure 3a.3. Creeks for tree fall analysis

For these two waterways, five 100m buffers have been created (see Figure 4). This has created some overlap between the two waterways, and also with the highway and the powerline study areas, however, they will be analysed separately and overlapping areas omitted from creek, powerline or highway as necessary to avoid confounding comparisons.

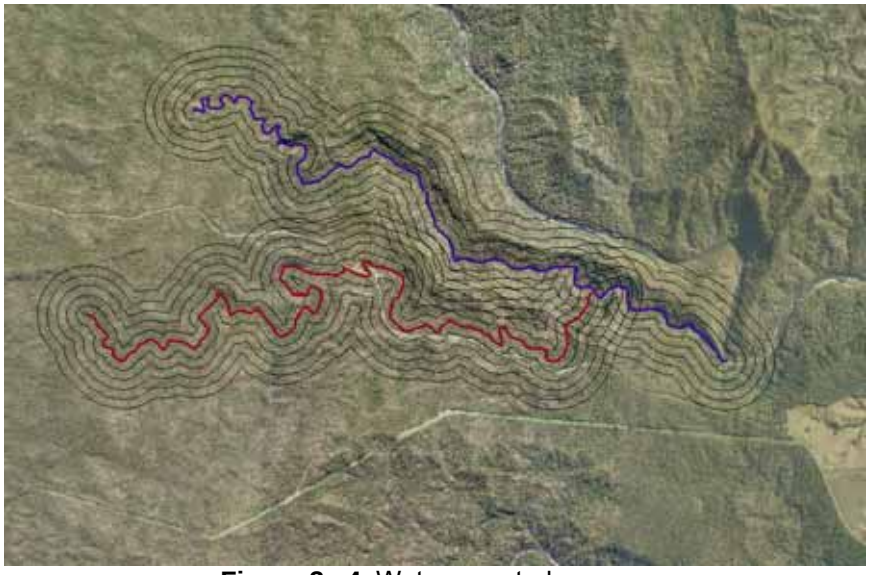


Figure 3a.4. Waterway study areas.

4. Study sites from Pohlman et al. (2007)

The sites identified in Catherine Pohlman's study have been imported into GIS and can be seen in Figure 3a.5. All sites fall on the relevant linear clearing, with the exception of one, which is highlighted and labelled Hwy 2, which requires further GPS locational data. A 100m buffer has been created around these sites as a study area for tree fall analysis that will allow comparison of the detailed field data of vegetation damage to species level with aerial photographic analysis of damage.

Figure 3a.5 Study sites of Pohlman *et al.* (2007) and 100m buffer areas.

5. Treefall digitization

In these sample areas tree lines have been digitized where the trunks of fallen trees can be identified. Due to the resolution of the airphotos, number of tree falls will be used as an indicator for the amount of damage that has occurred in an area.

6. Tree fall analysis

In each of the 10,000 m^2 sample areas (i.e. 100m, 200m, 300m, 400m and 500m from the clearing or waterway) tree falls have been recorded. Each of these areas will be compared in order to examine patterns in damage particularly with distance from the linear clearing edge (i.e. more or less fallen trees closer or further away from the linear clearing). Statistical analysis will involve homogeneity tests and analyses of variance (either parametric or non-parametric depending on data normality). Further statistical comparisons between linear clearing types will also be undertaken.

Damage on the southern and northern sides of the highway and powerline clearings may be compared. Further analysis may include dividing the clearings (particularly the powerline corridor) into sections based on the direction of cyclone travel to examine relationships between tree falls and tree fall orientation with distance from the path of the cyclone core. Tree fall orientation may be further examined where practicable for wind directional information.

Task	Progress
Sample area identification	Completed
Tree fall digitization	Completed. In total, • 660 100mx100m areas for the powerline and highway corridors. • The waterways study area consists of 7375 m^2 in total. • Study sites for Pohlman *et al*. (with 100m buffers, 8 in total) consist of an area of approximately 500 m^2.
Analysis of data – • χ^2 test of homogeneity – amount of damage per distance from corridor • tree fall orientation χ^2 test of homogeneity • Comparison between linear corridor types	In Progress
Collation of results	
Report writing	

Table 3a.2. Progress table.

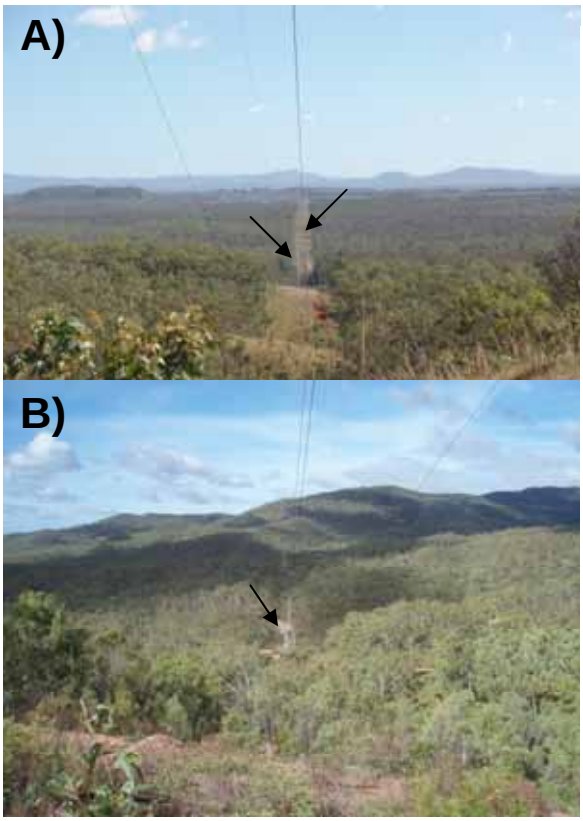
Appendix 3b

Progress Report: Edge effects of powerline clearings on microclimate and vegetation in tropical savanna ecosystems.

This study is a collaborative project with Powerlink Queensland. Research is being undertaken in the Davies Creek and Dinden National Parks (Figure 3b.1), west of Cairns. The current status of the fieldwork components of this project is outlined in Table 3b.1.

The scale of this project has been expanded by 50% at the request of Powerlink Queensland. Fieldwork was initially planned for two sites (16° 59' 41" S, 145° 32' 55" E and 16° 59' 29" S, 145° 33' 11" E) but an extra site (16° 58' 28" S, 145° 34' 28" E) was added in January 2007. The addition of an extra site has slowed the completion of the survey of trees and shrubs (although this survey is currently 83% complete) and has required additional field days, increased sample processing and data analysis for all other components of the project. A variation to cover the costs associated with this additional field work, and to extend the period of the contract of the principal researcher (Dr Catherine Pohlman) has been verbally agreed with Powerlink Queensland. It is anticipated that the addition of the extra site will require the duration of this project to be extended from the original date of 31st January 2008 until 31st March 2008. Consequently, the final report for this project is now scheduled to be completed in March 2008.

Preliminary analysis of wet season microclimate data is currently underway.



The Davies Creek powerline clearing. Clearing width is 30 m. Views to the southwest (panel A) and the northeast (B), with approximate site locations indicated.

Figure 3b.1

Fieldwork Component	Tasks	Progress
Microclimate Measurements		
	Wet season measurements (March – April 2007)	Completed.
	Early dry season measurements	Scheduled for June 2007
	Late dry season measurements	Scheduled for September – October 2007
Species Composition of the Vegetation Community		
	Survey of trees and shrubs	83% completed. Commenced December 2006, estimated completion by August 2007.
	Wet season survey of grasses and herbs	Sample collection complete. Grass biomass samples are currently being processed (estimated completion by July 2007).
	Early dry season survey of grasses and herbs	Scheduled for June 2007
	Late dry season survey of grasses and herbs	Scheduled for September – October 2007
Physical Disturbance		
	Survey of fallen trees (undertaken as part of tree and shrub survey)	83% completed. Commenced December 2006, estimated completion by August 2007.
	Leaf litterfall samples Wet season Early dry season Late dry season	 Collection complete. Samples currently being processed. Scheduled for June 2007 Scheduled for September – October 2007
Soil Seed Bank		
	Wet season	Sample collection complete. Samples currently being monitored (estimated completion November 2007)
	Dry season	Scheduled for September 2007 (monitor until March 2008)

Table 3b.1. Savanna edge effects research progress.

Appendix 5

Journal of Environmental Management (in press).

Vehicle noise attenuation through tropical rainforest at ground and lower canopy levels: distance penetrated by noise disturbance.

Gregory DAWE, Miriam GOOSEM*

School of Tropical Environment Studies and Geography, James Cook University, P.O. Box 6811, Cairns, Queensland, 4870, Australia

Abstract

The penetration of vehicle noise disturbance from a highway into tropical rainforest was investigated in North Queensland, Australia. Noise data collected along eight replicate transects at distances of 0, 5, 10, 20, 50, 100 and 200 metres from the highway edge indicated that a vehicle traveling at 80 km/hr produced a significant transformation of the acoustic environment at both one metre and fifteen metres above the rainforest floor for distances greater than 200 metres, with mean noise (decibel) levels in the dominant frequency band of the test vehicle (800Hz) more than twice those of pre-test ambient noise at 200 metres and at least 50% higher than mean daytime noise levels from a control site. Regressions suggested that ambient levels would be reached at about 350 metres into the forest for total noise and 650 metres for dominant frequency noise. Propagation characteristics of traffic noise were different at ground and lower canopy levels, demonstrating greater attenuation losses closer to the ground. A spectrum shift towards lower frequency bands was identified at 200 metres inside the forest during test vehicle passes when compared with ambient noise, partially blanketing an acoustic window thought to be used by many faunal species for communication. Less intense edge effects upon the acoustic spectrum occurred even without the presence of vehicles. Broadband transformations in the acoustic spectrum due to vehicles may impact on rainforest fauna, potentially masking communications of birds and amphibians using lower frequencies and/or causing road edge avoidance even in species calling at higher frequencies.

Geographical Research (in press)

Assessment of Riparian Rainforest Vegetation Change in Tropical North Queensland for Management and Restoration Purposes

TINA LAWSON*, DAVID GILLIESON and MIRIAM GOOSEM

School of Earth and Environmental Sciences, James Cook University, PO Box 6811, Cairns,Qld 4870, Australia.

**Corresponding author. Email: Tina.lawson1@jcu.edu.au*
Running title: Tropical riparian vegetation change
Received 21 November 2006; Revised 1 May 2007; Accepted 3 June 2007

Abstract

Changes in riparian vegetation extent in northern Queensland, Australia were assessed using aerial photographs from 1944 and 2000. Change in riparian extent was recorded as vegetation gain or loss. Changes in density were recorded as vegetation thickening. Riparian forest coverage increased by 22 ha during this time period in the Mossman River catchment. A total of 124 ha of riparian forest were gained, while 101 ha of riparian forest were lost. A further 59 ha of forest increased in density over this time period. Clearing, changes in farm management practices and natural stream channel movement have been identified as three potential causes for these changes. Areas with little or no riparian vegetation were identified and categorised into priority levels for potential revegetation efforts.

Pacific Conservation Biology (in press).

Rapid assessment of habitat quality in riparian rainforest vegetation

Tina Lawson*, Miriam Goosem and David Gillieson

School of Tropical Environment Studies and Geography, James Cook University, Cairns, Queensland, Australia 4870
School of Earth and Environmental Sciences
James Cook University
PO Box 6811
Cairns, QLD, 4870
Ph) 07 4042 1111

ABSTRACT

GIS and aerial photographic techniques were applied to assessing riparian vegetation quality in an agricultural landscape formerly covered in lowland rainforest. Canopy cover and width of woody riparian vegetation, both easily determined from remotely sensed data, were investigated as indicators of riparian quality. High correlations between field measurements of canopy cover and width of woody riparian vegetation with several other vegetation attributes indicative of vegetation quality (weed abundance, debris, human disturbance, native species richness) demonstrated that these two habitat attributes were suitable field vegetation quality surrogates. Desktop quality analysis combined GIS measurement of riparian width with aerial photographic analysis of canopy cover. Desktop quality equalled field quality in 78% of cases, with a further 13% showing errors due to clearing or thickening of vegetation after aerial photographs were taken.

Bird communities in higher vegetation quality areas comprised mainly rainforest-dependent species, whereas poor quality areas mostly supported birds of open habitats. Bird community diversity and rainforest-dependent bird diversity increased significantly both with increasing levels of canopy cover and greater riparian width, but a combination of these factors explained more variance than each factor separately. Desktop riparian vegetation quality therefore proved a satisfactory indicator of habitat quality for birds in rainforest riparian zones.

This quick and efficient desktop method of riparian habitat quality assessment can determine conservation values of rainforest riparian areas with minimal field validation, thereby allowing more effective targeting of appropriate management practices, identification of areas of conservation concern and prioritisation of revegetation and rehabilitation efforts.

Biotropica 39, 62-71.

Edge Effects of Linear Canopy Openings on Tropical Rainforest Understorey Microclimate

Catherine L. Pohlman, Stephen M. Turton and Miriam Goosem

Rainforest Cooperative Research Centre (CRC) and the School of Tropical Environmental Studies and Geography, James Cook University, PO Box 6811, Cairns, Queensland, 4870, Australia.

ABSTRACT

We investigated microclimatic edge gradients associated with powerlines, highways and creeks in wet tropical forest in north-eastern Australia during wet and dry seasons. Photosynthetically active radiation, air temperature and vapour pressure deficit, soil temperature, canopy temperature, soil moisture and air speed in the rainforest understorey were measured during traverses. Light intensity was elevated near the edges of powerlines, highways and creeks, but this effect was strongest for creek edges. Air temperature and vapour pressure deficit were elevated near powerline edges in the dry season and highway edges in both wet and dry seasons but were not elevated near creek edges in either season. In contrast, soil moisture was lowered near creek edges but not near either powerline or highway edges. No edge gradients were detected for air speed. Canopy temperature was elevated near highway edges and lowered near powerline edges in the wet season but no edge gradients in canopy temperature were detected near creek edges in either the wet or the dry season. We suggest that these different edge gradients may be largely the result of differences in the fluxes of latent and sensible heat within each type of linear canopy opening, although periodic flood disturbance may be maintaining a more open canopy near creek edges. These data indicate that the nature of the linear canopy opening is at least as important as the width in determining the nature and severity of microclimatic edge effects, analogous to the “matrix effect” of traditional fragmentation studies.