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Department of the Environment, Water, Heritage and the Arts

Marine and Tropical Sciences Research Facility Milestone Report, November 2009

**Program 9: Sustainable Use, Planning and Management of
Tropical Rainforest Landscapes**

**Project 4.9.3: Impacts of urbanisation on North Queensland environments:
Management and remediation**

Project Leader: Professor Steve Turton, James Cook University (JCU)

Summary

The project has been making steady progress. Field vegetation and microclimate assessments of the habitat quality of remnant, riparian and continuous forest sites in the coastal Mission Beach area have been completed, as have two rounds of bird observations. A third round of bird sampling commenced in the 2009 dry season and is currently underway.

Dr Catherine Pohlman's post-doctoral fellowship funding ended at the end of January 2009, with completion of substantial work on analysis of vegetation and microclimate data for the remnant and riparian habitat quality assessment. Dr Pohlman and Dr Miriam Goosem presented analyses of the vegetation and microclimate, and the preliminary bird assessments to an international audience at the 10th International Congress of Ecology in Brisbane in August 2009.

Since January 2009, research officers Les Searle, Dr Robyn Wilson, Les Moore, Adrian Walker, Dr Martin Cohen, Silas Dick and Dr Elaine Harding have also been employed for short periods or part-time for longer terms on various aspects of the project using a combination of MTSRF, Queensland Department of Main Roads, Terrain NRM Ltd, Wet Tropics Management Authority and Cairns City Council funding.

An invited article reviewing road impacts and mitigation in tropical forests has been published in the prestigious journal *Trends in Ecology and Evolution*. The ISI Web of Knowledge [Essential Science Indicators](#) rank the journal second highest for annual impact factors and article influence out of 124 journals in ecology and evolution, highest impact over the longer (five-year) term and third highest for immediacy because articles in the journal are noticed and cited very quickly. The article earned the cover photo of the journal issue.

A second article has been published in another high-ranking journal (*Agricultural and Forest Meteorology*, the top-ranked journal for annual and long-term impact and influence in the forestry field) while another has been revised and resubmitted to a road impacts special issue of *Ecology and Society*. The final draft of the best practice manual 'Roads in Rainforest: Best Practice Guidelines – Planning, Design and Management' and the accompanying 'Science behind the Guidelines' document have been submitted to Queensland Department of Main Roads.

The remnant and riparian habitat quality project has progressed steadily. Vegetation and microclimate data has been analysed for the 44 sites chosen from the remotely sensed

habitat quality assessment within continuous, remnant and riparian forests in the Mission Beach coastal area. The first two rounds of bird observations at the 44 sites were completed during the dry season of 2008 and the late wet season of 2009. A third round has commenced in the 2009 dry season. We appreciate the assistance of Terrain NRM Ltd for contact details, MTSRF Project 4.9.5 for rapid assessment methodology and especially Mission Beach landholders, who have generously allowed access to their private lands and with whom we have communicated regularly. Remote sensing of aerial photographs for almost the entire rural and urban region encompassing areas from the Bruce Highway west to Tully and Feluga, east to Bingil Bay, Mission Beach and north beyond El Arish, including the Walter Hill Range across Smith's Gap should be completed by the end of December. This schedule provides sufficient time to incorporate ground-truthed data from the coastal strip, adjust habitat quality accordingly and complete prioritisation of restoration requirements in the vicinity of streams and remnants so that the final reports and journal articles can be produced by June 2010. Emphasis has been placed on the Walter Hill Range area due to its importance in connectivity between coastal rainforests and rainforests of the escarpment and Tablelands.

A draft report detailing cassowary activity adjacent to roads in the Mission Beach area was completed and submitted to Terrain NRM Ltd in June 2009. The report incorporated information concerning traffic volumes and speeds in the Mission Beach area collected over the past year. Camera trap monitoring of the rope canopy bridges across the Palmerston highway between Millaa Millaa and Innisfail recommenced in August 2009 after funding was received from the Wet Tropics Management Authority. Queensland Department of Transport and Main Roads have provided video cameras to allow three bridges to be monitored regularly.

Pamela Schultz has completed the field research for her PhD. In total, Pam carried out 44 interviews with the 32 participants. Pam has submitted a revised version of her methodology chapter to the supervisory team and is currently analysing her interview data using the Ecosystem Services Framework (based on the [Millennium Ecosystem Assessment](#)) to study the ecosystem goods and services/disservices interviewees identified. She is aiming to present the results from her research in two result chapters/journal articles.

Project milestones extracted from Project Schedule

Targeted Activity	Due Date
<ul style="list-style-type: none"> • Progress report regarding effectiveness of overpasses, subject to renewed funding by the Queensland Department of Main Roads to monitor faunal under and overpasses (Objective A); • Progress report for Mission Beach area on activities associated with Objective B <i>Remote sensing and GIS analyses of riparian and remnant vegetation quality indicators</i> (Objective B); • Summary of any communication activities undertaken to date, including minutes of meetings/workshops if applicable; • Progress update on activities associated with Objective C. Responsible office: Dr Iris Bohnet (CSIRO). Summary of communication activities, number of interviews carried out in case study areas that inform analysis of landscape values. 	<p>14 November 2009</p>

Project Results

1. Progress report for Mission Beach area on activities associated with Objective B *Remote sensing and GIS analyses of riparian and remnant vegetation quality indicators*

This project commenced in August 2007 with a stakeholder workshop to rank priority regions for the analysis, with Mission Beach being highest ranked. Aerial photograph interpretation by Les Searle (JCU) commenced in 2007 and was completed for the rapidly urbanising area along the coastal strip between Bingil Bay and South Mission Beach by April 2008, although difficulties were encountered due to large amounts of damage from Severe Tropical Cyclone *Larry*. Interpretation of aerial photographs for the Walter Hill Range between the coastal strip across Smith's Gap commenced in October 2008 and, together with the rural Feluga area to the north of Tully and area near El Arish, was completed by June 2009. Final filling-in of gaps to the ranges, checking of the student project involving part of the Feluga area, and filling of gaps along the Tully-Mission Beach Road is currently underway. The interpretation of levels of canopy cover uses novel techniques for digital image interpretation developed in our laboratory which increased the speed of analysis over manual methods.

Field-truthing of the remotely sensed data for the Mission Beach coastal strip commenced in May 2008 by selecting sites, contacting private landholders and obtaining government permits where necessary. Terrain NRM Ltd provided assistance with landholder information for riparian and remnant sites. There are 32 remnant and riparian sites, the majority of which are privately owned, whilst the majority of twelve continuous forest sites fall within protected tenures. Vegetation and microclimate assessments were completed by January 2009 adapting vegetation methodologies from the [vegetation monitoring toolkit](#) developed as part of [MTSRF Project 4.9.5](#). Microclimate measurements were undertaken in the extremes of the dry season to examine surrogacy potential for habitat quality. Bird survey methodologies were also adapted from those used by the Project 4.9.5 team with the first dry and late wet season observations completed by May 2009. A second dry season data collection is currently underway. Data analysis for vegetation and microclimate was completed for presentation at the [10th International Congress of Ecology](#) held in Brisbane in August 2009. Preliminary data analysis of the first two sets of bird observations were also presented at that meeting.

Bird data collection should be completed by April 2010, allowing final analysis before June 2010. Final gap-filling of remotely sensed data will be completed by December 2009 so that the coverage incorporates the rural and urban area from the ranges west of Tully through the Feluga area north beyond El Arish, east to Bingil Bay through to South Mission Beach. Particular emphasis has been placed on the Walter Hill Range due to its importance in providing a connectivity link between the rainforest of the escarpment and Tablelands to the west and the protected areas of the Mission Beach region. This schedule for the remote sensing ensures that sufficient time remains till June 2010 to incorporate ground-truthed data from the coastal strip, adjust habitat quality accordingly and complete prioritization of restoration requirements in the vicinity of streams and remnants so that the final reports and journal articles can be produced.

2. Report report regarding effectiveness of overpasses, subject to renewed funding by the Queensland Department of Main Roads to monitor faunal under and overpasses

Although funding was not available from the Queensland Department of Main Roads, the Wet Tropics Management Authority has generously provided sufficient funding at a reduced level to allow full camera-trap monitoring of the rope canopy bridges by Dr

Martin Cohen each month. Downloads from the cameras can occur in other weeks during monitoring of road mortality in the vicinity of the East Evelyn underpasses and examination of animal use of underpasses using sand-tracking. Queensland Main Roads has provided video cameras to allow greater canopy bridge monitoring coverage than would otherwise have been possible.

Traffic counters remain installed at Mission Beach to examine traffic volumes and speed.

3. Progress update on the Queensland Main Roads Best Practice Guidelines revision

The final draft revising the [best practice guidelines for road infrastructure in rainforest habitats](#) has been submitted to Queensland Main Roads. The employment of Dr Elaine Harding part-time using \$5,000 Main Roads funding to revise the last draft made this project possible. Email communications between Dr Harding, Dr Miriam Goosem and Brisbane based Queensland Main Roads personnel have continued. The document comprises two volumes: a succinct guidelines document with illustrations (figures and photographs) and a larger reference science background document. Decisions regarding the publishing process await Queensland Main Roads comment.

4. Summary of communication activities undertaken during the past six months, including minutes of meetings/workshops if applicable

- Dr Miriam Goosem and Les Moore attended the Mission Beach Habitat Network Action Committee meeting in June 2009. Correspondence regarding the October 2009 meeting and transfer of habitat assessment data to the model is continuing with [MTSRF Project 4.9.6](#).
- Communication with private landholders at Mission Beach has continued regarding access to private lands where habitat quality assessments can be carried out. Multiple phone calls have been made to many landholders to request suitable times for researcher access. Some landholders have requested data obtained on their properties and this has been provided.
- Informal contacts at other meetings and during field work have provided environmental advice from researchers to Queensland Main Roads, Queensland Department of Environment and Resource Management (DERM) and the Wet Tropics Management Authority (WTMA) regarding various projects including those concerning the rope canopy bridges over the Palmerston Highway, Mission Beach culverts and underpasses and traffic conditions at Mission Beach.
- Email and phone contacts and digital submissions have assisted in liaising with Queensland Main Roads in Brisbane regarding the Best Practice Guidelines documents, which are now under review by Main Roads and with WTMA and DERM personnel in Cairns.
- Dr Miriam Goosem attended the WTMA cassowary summit in Cairns in September 2009 and the scientific expert panel concerning cassowary population assessments the following day.
- Dr Miriam Goosem, Dr Catherine Pohlman, Professor Steve Turton and Peter Byrnes attended the 10th International Congress of Ecology in Brisbane, Australia in August 2009, and presented the following papers:

M. Goosem, C. Pohlman, L. Searle and A. Walker (2009) *Bird assemblages and habitat quality of fragmented rainforest during post-cyclone recovery*. 10th International Congress of Ecology, Brisbane Australia, August 2009.

C. Pohlman, M. Goosem and L. Searle (2009) *Prioritisation of rainforest remnants for conservation and restoration using two assessment methods*. 10th International Congress of Ecology, Brisbane Australia, August 2009.

M. Goosem, N. Weston, R. Wilson and M. Cohen (2009) *Canopy bridges: Encouraging connectivity across rainforest roads and highways*. 10th International Congress of Ecology, Brisbane Australia, August 2009.

P. Byrnes and M. Goosem (2009) *Road avoidance and barrier effects of roads on medium-sized, ground-dwelling rainforest mammals*. 10th International Congress of Ecology, Brisbane Australia, August 2009.

- Dr Miriam Goosem was invited to present at the Environment Institute of Australia and New Zealand (EIANZ) National Road Symposium in Brisbane in May 2009, including the final summary collaborative talk with Mr Bruce Jennison of WTMA, Mr Nigel Tucker of *Biotropica* and Mr David Rivett of *Environment North*.

M. Goosem, N. Tucker, D. Rivett and B. Jennison (2009) *The Queensland Wet Tropics: A case study in best practice planning through interdisciplinary collaboration*. EIANZ National Symposium, *Breaking the Barriers: Engineering Solutions to Ecological Problems*, Brisbane, May 2009.

She also presented a speed talk and a longer talk at the science forum the previous day.

M. Goosem (2009) *Underpasses and canopy bridges across rainforest roads. Where to from here?* EIANZ National Symposium, *Breaking the Barriers: Engineering Solutions to Ecological Problems*, Brisbane, May 2009.

M. Goosem, C. Hoskin and G. Dawe (2009). Traffic noise impacts on rainforest frog and bird abundance and calls. EIANZ National Symposium, *Breaking the Barriers: Engineering Solutions to Ecological Problems*, Brisbane, May 2009.

- Journal articles submitted or published this year include:

Laurance, W.F., Goosem, M. and Laurance, S.G. (2009) Impacts of roads and linear clearings on tropical forests. *Trends in Ecology and Evolution* 24(12) 659-669 (Impact Factor 11.9) (See [abstract](#), [this document](#))

Pohlman, C., Turton, S. and Goosem, M. (2009). Temporal variation in microclimate edge effects near powerlines, highways and streams in tropical rainforest. *Agricultural and Forest Meteorology* 149: 84-95 (Impact Factor 3.667) (See [abstract](#), [this document](#))

Hoskin, C. and Goosem, M. (Revised) Road impacts on abundance, call traits and body size of rainforest frogs in northeast Australia. *Ecology and Society*.

- A great deal of international and local publicity was received regarding the high impact *Trends in Ecology and Evolution* article – many Indian and American newspapers published articles as did The Cairns Post on the environment page and several other Australian news organisations.
- A journalist from the New Yorker magazine will visit Cairns in December 2009 to collect information for a road impacts article.



To access the Laurance *et al.* paper in *Trends in Ecology and Evolution*, visit <http://www.sciencedirect.com> (account required)

5. Progress update on activities associated with Objective C. Summary of Confirmation Seminar, communication activities, number of interviews carried out in case study areas that inform analysis of landscape values. *Responsible officer: Dr Iris Bohnet (CSIRO)*

Ms Pamela Schultz has completed field research for her PhD. Thirty-two people participated in her study; sixteen from the 'tree-change' area covering Myola, Speewah and Kuranda and sixteen from the 'sea-change' area covering Machans Beach, Holloways Beach and Freshwater. In total, Pam carried out 44 interviews with the 32 participants. The additional interviews were conducted with some of the interviewees after a preliminary analysis of the data to clarify the information obtained in the first interview and to ask additional questions that were not covered in the first interview.

Pam has submitted a revised version of her methodology chapter to her PhD supervisory team and is currently analysing her interview data using the Ecosystem Services Framework (based on the Millennium Ecosystem Assessment) to study the ecosystem goods and services/disservices interviewees identified. She is aiming to present the results from her research in two result chapters/journal articles. Research findings to date have been communicated at two conferences since the last milestone reporting period. Dr Iris Bohnet attended the [15th International Symposium on Society and Resource Management](#) in Vienna, Austria in July 2009 and presented a talk entitled *Landscape perception and preferences driving amenity migration: Case studies from the Wet Tropics, Queensland Australia*, based on her research in the Mossman, Julatten, Tully and Mission Beach areas.

Pam Schultz and Iris Bohnet attended the [Institute of Australian Geographers Conference](#) in Cairns in September 2009. Pam presented a talk that linked in with the 'Caring for our country' session in which she presented: *Exploring contrasts: who cares for our country?* The empirical data on which her presentation was based were from interviews with 'tree-changers' in the Kuranda/Myola area.

Iris Bohnet presented her talk in the 'Land, livelihood and demographic change in the tropics' session: *Exploring the effects of sea and tree-change phenomena in Far North Queensland*.

An invited book chapter on *Sea- and tree-change phenomena in Far North Queensland, Australia: Impacts of land use change and mitigation potential* has been prepared and is now in press. The journal article *Patterns, drivers and impacts of urban growth: A study from the Cairns region, Queensland, Australia from 1952-2031* has been internally approved by the CSIRO and has been submitted to the journal *Landscape and Urban Planning*. Feedback on the paper has been sought from the Department of Infrastructure and Planning.

Activity changes

Les Searle continues his analysis of aerial photographs of the Mission Beach study region, including the Walter Hill Range which has the potential to provide connectivity between the Wet Tropics World Heritage Area uplands and Mission Beach lowlands across the Smith's Gap Bruce Highway and Railway areas, the Feluga area (checking Masters student's analysis), and the Tully-Mission Beach Road area. Although the degree of cyclone damage experienced in the Mission Beach region selected as highest priority by the stakeholder workshop necessitated much greater input of time and resources to aerial photograph interpretation, the result will be a far more useful product that will feed into the MTSRF

Project 4.9.6 Mission Beach Habitat Network Action planning process. Field-truthing of the coastal strip area is now complete as scheduled, other than for further bird surveys.

Problems/opportunities

The cassowary workshops and Environment Institute of Australia invited papers presented opportunities for communication and the publicity generated by the *Trends in Ecology and Evolution* article has increased the public profile of the road ecology group.

Abstract 1

Impacts of roads and linear clearings on tropical forests

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Linear infrastructure such as roads, highways, power lines and gas lines are omnipresent features of human activity and are rapidly expanding in the tropics. Tropical species are especially vulnerable to such infrastructure because they include many ecological specialists that avoid even narrow (<30-m wide) clearings and forest edges, as well as other species that are susceptible to road kill, predation or hunting by humans near roads. In addition, roads have a major role in opening up forested tropical regions to destructive colonization and exploitation. Here, we synthesize existing research on the impacts of roads and other linear clearings on tropical rainforests, and assert that such impacts are often qualitatively and quantitatively different in tropical forests than in other ecosystems. We also highlight practical measures to reduce the negative impacts of roads and other linear infrastructure on tropical species.

Access the full article [online](#) (access to [Science Direct](#) subscription required).

Abstract 2

Temporal variation in microclimatic edge effects near powerlines, highways and streams in Australian tropical rainforest

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We investigated diurnal variation in edge gradients of air temperature, vapour pressure deficit (VPD) and wind speed in tropical rainforest in northeastern Australia, adjacent to three types of linear canopy openings: a powerline, a highway and a perennial stream. Edge gradients were compared between the wet and dry seasons. Diurnal ranges of air temperature and VPD were elevated near powerline, highway and stream edges and were greater in the dry season than the wet season although this seasonal difference in temperature ranges was less pronounced near powerline than highway or stream edges.

Maximum wind speeds were elevated near all three forest edge types, this increase being most pronounced at stream edges. In contrast, although daytime temperature and VPD were also elevated near all three forest edges, stronger effects were experienced at powerlines and highways compared with streams. Wind speed was greater near forest edges than in the forest interior during the daytime, but this effect varied between seasons and among edge types. Edge gradients in wind speed were present near powerline edges in both wet and dry seasons, but only occurred near highway edges during the dry season and near stream edges during the wet season. Nocturnal microclimatic edge gradients were seldom detected. They were observed only for air temperature near powerlines during the dry season, air temperature being reduced at the forest edge compared with the forest interior. These data indicate that linear clearings for roads and powerlines are associated with microclimatic edge gradients qualitatively similar to those observed in other studies at forest edges adjacent to larger clearings. Such gradients have the potential to substantially increase the edge exposure of forest areas internally fragmented by clearings for human infrastructure.