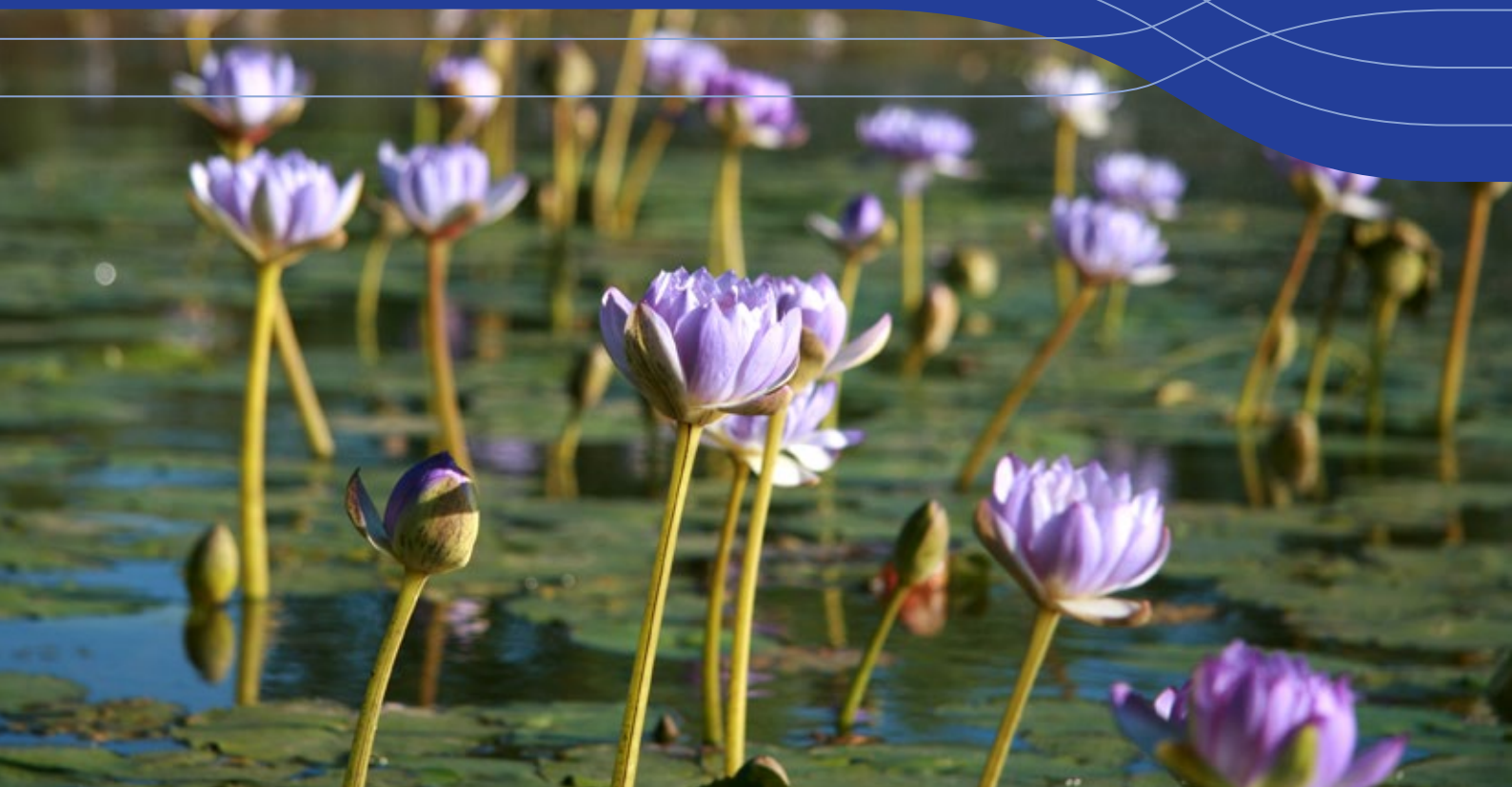


# Achievements report 2014

A summary of achievements by  
CSIRO's Land and Water Flagship in  
Darwin, Northern Territory



## Citation

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## Report background

This report is a summary of achievements in 2014 by the tropical savanna researchers at the CSIRO Tropical Ecosystems Research Centre in Darwin. The researchers belong to the Biodiversity, Ecosystem Knowledge and Services Program of CSIRO's Land and Water Flagship. The Land and Water Flagship provides the science to underpin Australia's economic, social and environmental prosperity through stewardship of land and water resources ecosystems, and urban areas.

### Professor Alan Andersen

Chief Research Scientist, CSIRO Land and Water Flagship  
Site Leader, Tropical Ecosystems Research Centre, Darwin NT

February 2015

### COVER IMAGES

Main image: *Nymphaea violacea*. Bottom left: Senior Tiwi Traditional Owner, Bernard Tipiloura with the Tiwi Seasons and Tiwi Plants and Animals Calendars created with CSIRO in 2014. Bottom right: Dr Garry Cook and Tiwi College student Alex Kantilla.

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# Research achievements

We conduct interdisciplinary ecological research to inform sustainable land management and regional development in Australia's tropical savannas, with a particular emphasis on Indigenous lands. Our biophysical research aims to predict how savanna ecosystems vary in relation to rainfall and soils, and how they respond to land management, especially fire and grazing. Our socio-ecological research aims to identify the full range of ecological, social, cultural and economic values of land and water, and to incorporate them in land and water management. We have a particular commitment to engaging effectively with Indigenous stakeholders, and have developed our capacity to do this by recruiting specialist staff and by enhancing our relationships with Indigenous organisations and local communities.



Our research has four areas of particular focus:

1. **Savanna burning**
2. **Invertebrate biodiversity and ecosystem function**
3. **Indigenous Natural Resource Management**
4. **Rangeland ecology and management**

## 1 Savanna burning

Tropical savannas are Australia's most fire-prone biome, with up to half or more of many savanna landscapes being burnt each year. Fire plays a key role in maintaining savanna biodiversity, and also has an important influence on Greenhouse gas dynamics. Savanna burning makes a significant contribution to the nation's accountable (non-CO<sub>2</sub>) emissions through the release of methane and nitrous oxide. Savannas contain about 30% of Australia's terrestrial carbon

stocks, and fire strongly influences rates of carbon sequestration through its effects on tree growth and survival, litter decomposition and charcoal production. There is growing national and international interest in reducing the extent and severity of savanna fires for Greenhouse gas abatement. This has the potential to transform regional economies in northern Australia, and to provide welcome livelihood opportunities for remote Aboriginal communities. There needs to be an

integrated understanding of the effects of different fire management options on Greenhouse gas emissions and biodiversity values. Our research addresses the full range of biophysical and socio-ecological issues relating to savanna fire management for Greenhouse gas abatement, especially on Aboriginal lands.





## 1.1 Territory Wildlife Park fire experiment

**Contact: Prof Alan Andersen**

In 2003, as part of the national Bushfire Cooperative Research Centre, CSIRO established the *Savanna Burning* manipulative fire experiment at the Territory Wildlife Park, in collaboration with the Northern Territory Government and Charles Darwin University. The experiment focuses on the effects of fire frequency and intensity on biodiversity and ecological processes, especially relating to carbon sequestration.



### ACHIEVEMENTS IN 2014

- Charles Darwin University Masters student, Parash Subedi, worked with Dr Anna Richards on a project to better understand fine root turnover. He assisted with the final measurements of the root tubes (clear plastic tubes buried in the ground) that have been installed as part of the Territory Wildlife Park fire experiment. The aim of the root tube experiment is to understand fine root turnover under different patch types (tree or grass-dominated), fire regimes (unburnt, burnt every year, burnt every three years and burnt every two years in the late dry season) and the connection between changes to vegetation cover and root turnover. Photographs of roots were taken in the root tubes using a special root scanner and then analysed using image analysis software. Hemispherical photos of tree canopy cover and ground cover were taken at the same time. Measurements were made in February, April and September 2014 and February 2015.
- An assessment of grass diversity and abundance was undertaken in April and May 2014 in order to determine changes in grass species richness over time since implementation of the experimental fire regimes at the Territory Wildlife Park.
- Ants were sampled in each plot in May, and sample processing and identification has been completed.
- Experimental burning was conducted in June for the relevant early dry season fire treatments. Six Year 11 Indigenous Kormilda students participated in the savanna burning research program, as part of the 2014 Jack Cusack Science Program.
- Drs Garry Cook and Anna Richards visited the Max Planck Institute for Biogeochemistry in Jena, Germany to work with Drs Shaun Levick and Susan Trumbore on innovative approaches to measure and understand the dynamics of carbon in tropical savannas (see page 4).
- Charles Darwin University Masters student, Parash Subedi and French internship student, Alexandre Harivel, assisted with calibration of the LiDAR imagery from the Territory Wildlife Park fire experiment for estimation of aboveground woody biomass. In September and October over 4900 trees from four of the six experimental fire treatments at the TWP fire plots were marked with a differential GPS and a record was made of tree height, diameter and health. This information will be used in conjunction with vegetation characteristics recorded from LiDAR imagery collected in 2013 in order to develop a remote landscape-scale carbon accounting tool.
- French internship student, Sebastien Laurent, assisted with the collection of geo-referenced tree data from the Territory Wildlife Park and undertook statistical analysis of the individual stems to determine what effect the fire treatments were having on the dominant eucalypt species composition, abundance and size structure.
- A paper was published in the *Journal of Applied Ecology* on responses of ant communities to the first five years of experimental burning.

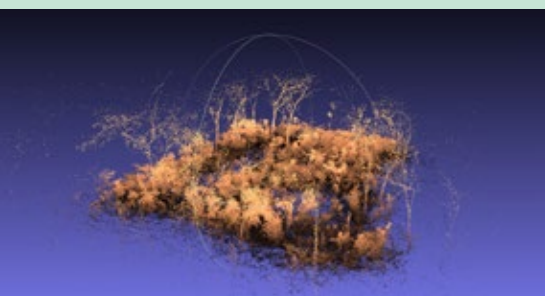


## Using Zebedee to record vegetation structure

CSIRO Land and Water colleagues Tom Jovanovic and Debbie Crawford visited Darwin in August to demonstrate to local researchers, Adam Liedloff and Jon Schatz, how to record the current state of vegetation in the Territory Wildlife Park fire plots with a hand held LiDAR unit. The unit, known as Zebedee, is able to track its position while the operator walks around each fire plot. Each sweep of the device records the position of hundreds of data points in space where the beam bounces back off structure, whether it's buildings or trees. This technique provides a three-dimensional cloud of points that allows vegetation structure to be analysed. At present, we are assisting with the development of software tools facilitate this analysis, and we hope to provide additional data for the airborne LiDAR as well as have a tool to measure changes in vegetation structure through time with different fire regimes.



From left, Charles Darwin University Masters student, Parash Subedi and CSIRO's Jon Schatz, Tom Jovanovic, Debbie Crawford and Adam Liedloff with the Zebedee unit.



This image of vegetation on fire plot B6 at the Territory Wildlife Park was recorded by the Zebedee unit. The image illustrates how the unit is able to record the vegetation structure close to the ground in great detail. This is the opposite of LiDAR recorded from a plane, where tree canopies are in greatest detail and the vegetation below the canopy is often missed.

## Visit to Max Planck Institute for Biogeochemistry in Germany

Dr Garry Cook received funding from the Australian Academy of Sciences' German-Australian Mobility Call to support a collaborative project with the Max Planck Institute for Biogeochemistry in Jena, Germany. The project also involved collaborators from Charles Darwin University, Flinders University and University of Western Australia. A key focus of the work was the use of LiDAR – an aircraft borne remote sensing tool – to improve our ability to assess vegetation structure and its dynamics in tropical savannas.

Dr Garry Cook and Dr Anna Richards visited the laboratory in Jena in May 2014, working with Dr Shaun Levick on the application of LiDAR imagery to understanding vegetation change on the Tiwi Islands and at the Territory Wildlife Park. A key benefit of this technique is it enables trees to be monitored in three dimensions with far more detail than is possible from traditional ground-based measurements.



Dr Anna Richards and Dr Shaun Levick from the Max Planck Institute for Biogeochemistry in Jena, Germany.

## Weedbusting at the Territory Wildlife Park

On Sunday April 13, CSIRO's Garry Cook and Jon Schatz worked with Territory Wildlife Park Biodiversity Officer, Sarah Hirst, and eight Territory Wildlife Park Community Involvement Day volunteers to manually remove Gamba grass (*Andropogon gayanus*) from the experimental fire plots. The following day a further ten CSIRO staff, including Brian Tippet (pictured) and students further cleared the research site. Gamba grass, an introduced species from sub-Saharan Africa, grows rapidly to form tussocks that are larger, taller and denser than native grasses. Tussocks cure late in the dry season, creating an unnaturally high fuel load that results in fires of unprecedented intensity. These fires can dramatically alter native plant communities and severely decrease local biodiversity. In 2006, only 58 Gamba plants were found and removed from the experimental fire plots. In 2010, this had increased to 275 plants. In 2012, the number of plants removed was 702 and by 2013, 1057 plants were found and destroyed, with some tussocks up to four metres high. In 2014, the number of plants removed dropped to 825, which indicates that the manual control program is paying dividends. Stands of perennial Mission grass (*Cenchrus polystachios*) and Hyptis (*Hyptis suaveolens*) were also removed.





## 1.2 Carbon and emissions dynamics in savannas

**Contact: Dr Garry Cook**

Reducing the severity of fire regimes reduces the emissions of nitrous oxide and methane in smoke and can increase the carbon stored in the landscape. Emissions abatement forms the basis of a carbon farming initiative methodology that is supporting land holders across the north in managing fires. CSIRO has worked with various partners including Aboriginal rangers, the Northern Land Council, the North Australian Indigenous Land and Sea Management Alliance (NAILSMA), Bushfires NT and Charles Darwin University, with funding from the Australian Government's Department of Environment, to reduce uncertainty in emissions estimates for savannas with annual rainfall greater than 1000 mm. Over the past year, our work with our partners has extended to better understanding emissions in drier savannas – down to 600 mm rainfall, and to carbon sequestration. The carbon sequestration work is also being pursued through a partnership with the Tiwi Land Council on the Tiwi Islands, which have Australia's wettest savannas.

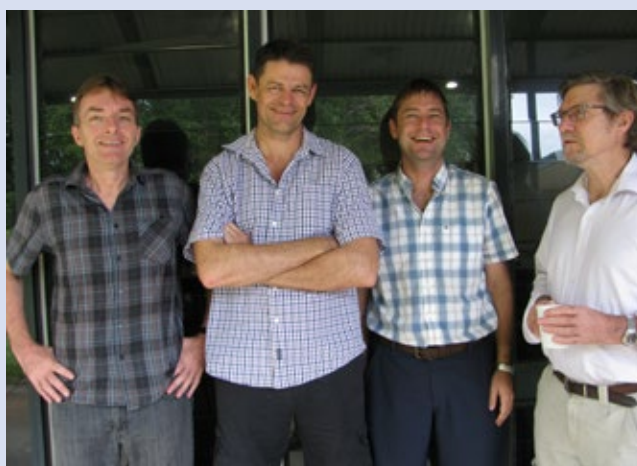


### ACHIEVEMENTS IN 2014

- As part of a project funded by NAILSMA, Dr Mick Meyer from CSIRO Marine and Atmospheric Research and Dr Garry Cook reviewed the dynamics and assessment of greenhouse gases emissions from savanna fires as a chapter in a forthcoming book on carbon accounting and savanna fire management. Their chapter described the issues extending the previous knowledge of fire emissions from high rainfall (>1000 mm) regions down to low rainfall (>600 mm) regions. They described their field-based measurements of methane and nitrous oxide emissions and their research into determining the factors that create variation in those emissions. Their work on nitrous oxide fills a major knowledge gap in this important greenhouse gas, which has been very difficult to measure accurately. Their research, together with that of partners in NAILSMA, NT government and CDU has contributed to the Australian government's carbon farming initiative through the savanna burning methodology and the complementary refinement of the national greenhouse gas accounts. By the end of 2014 this methodology had delivered about 1.2 million tonnes of CO<sub>2</sub>-e greenhouse gas abatement and improved fire management across more than 150 000 km<sup>2</sup> of northern Australia.

- In another project funded by NAILSMA, Drs Garry Cook and Adam Liedloff worked with Dr Brett Murphy from the University of Melbourne to quantify the carbon sequestration potential of changing fire regimes in the mainland savannas of northern Australia where the rainfall is greater than 1000 mm. This was to provide the basis for a carbon sequestration methodology to complement the emissions-abatement methodology. They reviewed the research on the role of both water and fire in limiting tree biomass in Australian savannas, and concluded that the overall abundance of trees in the Australian savannas is limited by water availability rather than fire, and that the potential for fire management to increase tree biomass

is relatively limited. Nevertheless, the dynamics of non-eucalypts in these eucalypt-dominated systems remains poorly understood and they may be much more responsive to changes in fire management. Under Australia's national greenhouse gas accounts, it has been assumed that the carbon stocks in live savanna tree populations do not respond to fire. Following statistical and process-based modelling, the research team concluded that there was no robust basis to depart from that assumption. Rather, by focussing on changes to the pools of carbon in dead biomass – leaf litter and logs – they developed a more robust approach to quantifying the changes in carbon stocks as a result of changing fire regimes.



From left, Charles Darwin University's Dr Peter Jacklyn and Dr Lindsay Hutley with CSIRO's Dr Adam Liedloff and Dr Mick Meyer at a workshop at CSIRO discussing progress on a collaborative book on carbon management in savannas.





## 1.3 Tiwi carbon study

**Contact: Prof Alan Andersen**

This partnership between the Tiwi Land Council, Tiwi Land Rangers, Tiwi Plantations Corporation, CSIRO and the Department of the Environment aims to identify the biophysical and economic potential of fire management for greenhouse gas abatement on the Tiwi Islands, as a basis for possible livelihood opportunities for Tiwi people.



### 1.3.1 Tiwi fire experiment

**Contact: Prof Alan Andersen**

The Tiwi Carbon Study features an experimental study of the effects of a range of fire management options on carbon sequestration and biodiversity, encompassing 18 experimental sites (50–100 hectares) across Melville Island. The study seeks to integrate fire management for greenhouse gas abatement into a broader framework for sustainable Tiwi livelihoods.

## ACHIEVEMENTS IN 2014

- All annual fire plots were burnt in the dry season, and post-fire assessments of fuel combustion were undertaken.
- A sixth year of assessment of fine fuel, coarse woody debris and shrub has been undertaken.
- Ant monitoring on all Tiwi carbon plots has continued.
- In April, soil sampling was undertaken at all of the fire plots (1404 samples in total). The soils were last sampled in 2009 and the aim is to detect any changes to soil carbon stocks and pools as a result of five years of changed fire regimes. This information will be used to (1) improve predictive capabilities of soil carbon models, and (2) to inform a carbon sequestration CFI (Carbon Farming Initiative) methodology for fire management of tropical savannas.
- University of Melbourne PhD student Hugh Davies, supervised by Dr Brett Murphy, continued his small-mammal monitoring program on the Tiwi fire plots using motion-sensitive cameras. Preliminary results show no strong relationship between fire and small mammal populations.
- Drs Garry Cook, Mick Meyer and Adam Liedloff developed a mathematical approach to quantifying how the stock of dead carbon in leaf litter and logs changes with changing fire regimes. This was a logical extension of previous work on emissions dynamics. They showed that taking account of the increases in dead carbon, the changes in fire management achieved in Western Arnhem Land could lead to several-fold increases in the accountable carbon benefits than considering methane and nitrous oxide emissions alone. This work supported the development of a draft carbon farming initiative methodology and proposed revisions to Australia's national greenhouse gas accounts.
- University of Melbourne PhD student, Michelle Freeman commenced her research as part of the Tiwi Carbon Study. She is supervised by Drs Brett Murphy and Peter Vesk from the University of Melbourne and by Drs Garry Cook and Anna Richards from CSIRO. Michelle is examining the mechanisms by which fire affects tree recruitment. This will improve understanding of how fire management can lead to increased carbon stocks in savannas to support participation in carbon markets. Michelle presented her research at the 2014 Ecological Society of Australia conference in Alice Springs.
- Results from the Tiwi Carbon Study were presented to the Tiwi Land Council, Tiwi Land Rangers and members of the Tiwi community at the 2013 Tiwi Islands Fire & Weed Management Meeting in December at Yapilika on Melville Island.



## STUDENT PROFILE

### Michelle Freeman

Michelle Freeman is a joint University of Melbourne and CSIRO PhD student.

Her research focuses on fire and vegetation dynamics on the Tiwi Islands. The question of how and to what extent fire affects tree growth, stand structure and composition in Australian high rainfall savannas is not yet fully understood, but is becoming increasingly important given recent focus on developing managed savanna burning projects for emissions abatement and carbon sequestration. Frequent fire, and increasingly intense fire since European settlement in northern Australia, most noticeably impacts juvenile and sapling trees. Fire can trap these small trees in the shrub layer for decades by subjecting them to a cycle of top-kill, where all above-ground parts of the plant are burnt, followed by resprouting. Consequently, the only way that a small tree can advance to a full-sized mature tree is if it is able to grow large enough in the period between fires to resist being top-killed, usually by attaining a certain height or bark thickness.

Eucalypts seem to be unique among savanna tree species in their ability to escape this “fire trap” through mechanisms that are still largely uncertain. As a result, Australian savanna overstoreys are dominated by eucalypt species. The more fire-sensitive non-eucalypt savanna trees appear to be most strongly limited by increasing fire frequencies and intensities. Michelle’s project aims to explore why eucalypts are so much more successful than other species under such fire regimes, and



**Tiwi Land Ranger, Willie Roberts, assisting Michelle Freeman with vegetation sampling for her PhD project.**

what the implications of managed fire regimes could be for overall tree biomass, stand structure and diversity. It will also lead to an increased understanding of the strategies plants use to persist in frequent fire environments through characterisation of traits that affect the way small trees grow and respond to fire.

The project is part of the Tiwi Carbon Study, a partnership between CSIRO, the Tiwi Land Council, the Tiwi Land rangers and Tiwi Plantations Corporation. Michelle has been working with Tiwi Land Rangers to tag and measure juvenile and sapling trees on Melville Island, and collect trait information for a range of common eucalypt and non-eucalypt savanna species. This information will allow us to better understand the effect of fire on small tree growth, mortality, resprouting and transition to larger size classes and work towards a comprehensive characterisation of the processes driving eucalypt and non-eucalypt contributions to overall tree biomass in Australian high rainfall savannas.



**The Tiwi Land Rangers have provided valuable support with data collection on Melville Island.**



## Soil nitrogen fluxes

Rates of soil nitrogen mineralisation during the Wet season was the focus of a Tiwi Carbon Study project undertaken by Leo Simon from SupaAgro University in Montpellier, France. Leo was looking at soil nitrogen mineralisation rates under three fire treatments – annual burn, burnt every three years and unburnt – as part of the long-term Tiwi fire experiment. Understanding soil nitrogen fluxes is crucial for modelling soil carbon



Leo Simon's project focussed on soil nitrogen mineralisation rates under three fire treatments as part of the long-term Tiwi fire experiment.

dynamics as the nitrogen cycle is intimately linked to the carbon cycle in terrestrial ecosystems. There have been very few studies of nitrogen mineralisation rates (the rate of conversion of organic N to readily plant-available inorganic N) in tropical savannas and how fire affects these rates, which has hindered accurate model predictions of soil carbon dynamics. In order to address this gap Leo incubated resin cores (novel PVC pipe tubes, carefully filled with soil and sealed at one end with ion-exchange resin, which allows water to flow through the core but traps charged nitrogen containing ions) in the fire plots for a month during the 2013-14 wet season. He extracted and analysed the soil and resin samples for inorganic (nitrate and ammonium) and organic (amino acid) N forms at the University of Queensland. Preliminary results show that N mineralisation rates in tropical savannas are very low and highest rates are found on annual burn sites; those with the shortest time since last fire.

## 1.3.2 Tiwi Carbon Farming Initiative (CFI) capability project

**Contact: Drs Anna Richards and Adam Liedloff**

This project aims to assist the Tiwi Land Council to develop a CFI project application using the savanna burning methodology, drawing on results from the Tiwi Carbon Study. In 2013 a vegetation map of the Tiwi Islands was developed and validated.



Tiwi Land Ranger, Jose Puruntatameri collecting vegetation data on Melville Island.

## Soil carbon analysis capability for northern and central Australia

One of the key impediments for detecting changes to soil carbon stocks and pools under different land use and management scenarios is the cost of soil sample analysis. The Soil Carbon Research Program (SCaRP) successfully developed a mid infrared (MIR)/Partial least squares regression (PLSR) capability to predict the content and composition of soil organic carbon for soils of southern Australia. MIR/PLSR models provide a rapid and cost-effective method for predicting

soil carbon content in soil, and this technique could dramatically improve soil carbon sampling efforts. However, recent MIR analyses conducted in the Darwin CSIRO lab (using a newly purchased MIR spectrometer) indicate that soils of the northern and rangeland regions of Australia can differ significantly from those of southern Australia. Extension of the MIR/PLSR predictive capability for soil carbon content and composition to northern and rangeland soils requires

the development of new models. In this project existing soil samples (~200) representative of northern and rangeland soils will be ground and analysed by MIR in both Darwin and Adelaide. Where required, soil carbon contents (total, organic and inorganic) will be determined in Adelaide. Based on the MIR spectra acquired, a subset of 10-20 representative soils will be fractionated to quantify the allocation of soil organic carbon to the particulate, humus and resistant soil carbon pools. MIR/PLSR predictive models will be constructed for soil carbon content and composition in northern and rangeland soils from the data acquired in this project augmented by appropriate SCaRP data.

The work should result in the derivation of MIR/PLSR models capable of predicting soil carbon contents and composition for northern and rangeland soils.

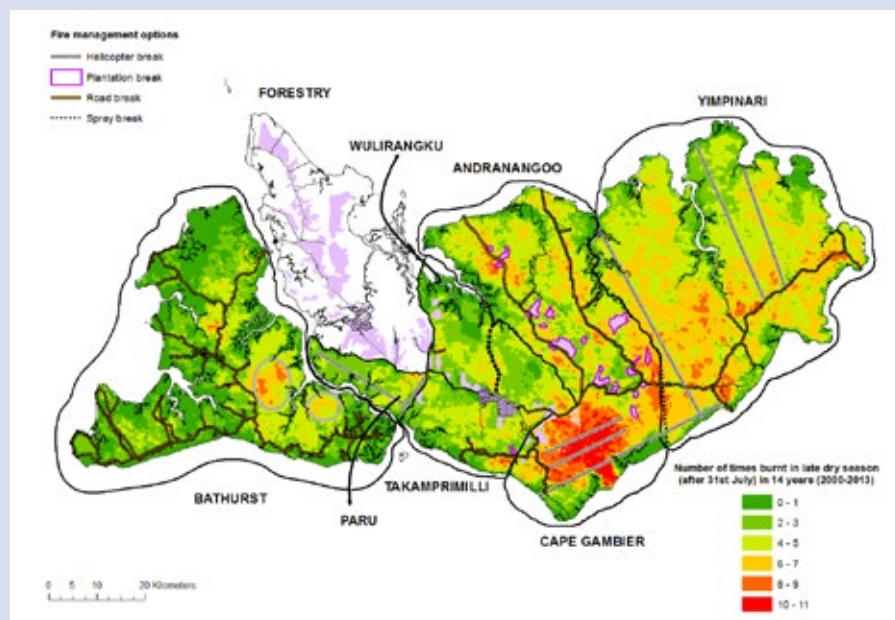
CSIRO's Sam Walker and Tiwi Land Ranger, Des Bruppacher, collecting soil samples on the Tiwi Carbon Study fire plots on Melville Island.





## ACHIEVEMENTS IN 2014

- CSIRO is a member of the Tiwi Islands Fire Management Committee, along with other stakeholders from a range of organisations operating on the Tiwi Islands. The Committee met regularly in 2014 and developed a fire management plan for the Tiwi Islands for the 2014 fire season. The plan involved implementation of strategic early dry season burning from helicopters and by road in order to reduce the extent of late dry season fires. Tiwi Enterprises and the Tiwi Land Rangers undertook the burning in the early dry season (May to July) and a final assessment of greenhouse gas emissions abatement is underway.



For fire-management purposes, the Tiwi Islands have been split into eight areas according to the landscape and natural features. The map shows the number of times an area has been burnt in the late dry season. Red areas have been burnt regularly and it is these areas that need to be burnt early to reduce greenhouse gas emissions, or protected from fire later in the season.

## 1.4 Modelling tree dynamics in Australian savannas and woodlands

**Contact: Drs Adam Liedloff and Garry Cook**

Eucalypt woodlands cover a vast area of Australia and understanding their dynamics is critical to managing them for biodiversity, carbon storage, catchment hydrology and production values. CSIRO staff in Darwin are engaged in a number of projects focussing on different aspects of Australian woodland dynamics.

## ACHIEVEMENTS IN 2014

- Drs Garry Cook and Adam Liedloff used the Flames model to explore the implications of equations developed to calculate tree carbon stocks from their stem diameter in northern Australia. The equations indicate that a stand of trees dominated by a large number of younger and smaller trees stores much less carbon than a stand dominated by few older and larger trees. This is despite the two stand types using similar amounts of water each year. The modelling indicated that over long periods, frequent fires can push tree stands towards an open structure dominated by large fire-tolerant trees. This is because smaller trees are much more fire sensitive. In contrast, very low fire frequencies result in more smaller trees in the modelling runs. There has been relatively little work published on tree stand structures and their dynamics in the north, but clearly they have great implications for carbon stock dynamics.

## Cyclone Tracy 40th anniversary

December 2014 marked the 40th anniversary of Cyclone Tracy's devastating impact on the city of Darwin. As chance would have it we recently discovered some lost photographs taken by CSIRO staff just after the 1974 cyclone. They show the very severe impact of the winds on trees on the CSIRO Berrimah site. Leaves were completely stripped from trees and a high proportion of trees were uprooted or had their trunk snapped. At the time, CSIRO was on the outer limits of the city and the tree damage is indicative of the extreme wind speeds. Nevertheless, the building survived and became temporary shelter to CSIRO staff and their families. Two CSIRO researchers, under what must have been horrendous conditions, showed a great dedication to duty by surveying tree damage in the Darwin area in the weeks following the cyclone and published one of the few papers on its effects on trees.



The CSIRO Darwin laboratory post Cyclone Tracy.



## 2 Invertebrate biodiversity and ecosystem function

Invertebrates are the ‘backbone of biodiversity’ in that they represent the vast majority of the world’s animal species. They are also the ‘little creatures that run the world’, playing critical roles in the functioning of ecosystems. Ants are the most important invertebrate group, representing greater than 20 per cent of terrestrial faunal biomass globally.

### 2.1 Ant diversity, biogeography and community ecology

**Contact: Prof Alan Andersen**

Ants are the dominant faunal group in Australian savannas, playing key roles in relation to nutrient cycling, energy flow, and vegetation dynamics. Australia has an exceptionally diverse ant fauna, but most species are undescribed. CSIRO in Darwin has played a leading role in documenting the fauna, and has assembled the world’s largest collection of Australian ants, with more than 6000 species. We are developing a predictive understanding of ant productivity, behavioural dominance and community dynamics globally, based on the recognition of functional groups that vary predictably in relation to environmental stress and disturbance.



#### ACHIEVEMENTS IN 2014

- PhD student, Sara Nowrouzi, continued working on her project entitled ‘*Ant species distributions in the Australian Wet Tropics: Predicting responses to climate change*’, supervised by Prof Andersen and Drs Simon Robson and Jeremy Vander Wal from James Cook University. Her project aims to:
  - Describe distributional patterns of ants and their climatic drivers across the Wet Tropics.
  - Investigate physiological responses to temperature changes of ants, with regards to climate change impacts.
  - Determine if regional distributional patterns of ants have been affected by past climates, using comparative phylogenetic approach in the Wet Tropics.
  - Develop ant species distribution models for informing ant responses to future climate change.

In 2014, Sara completed the processing and identification of samples from her ant surveys, and has drafted a manuscript on ant diversity and distribution in the Australian Wet Tropics.



- Brazilian PhD student, Gabriela Burle Arcoverde, continued her project investigating how both historical and ecological biogeography can influence the responses of savanna ant communities to grazing by livestock. Responses to disturbance might be expected to vary along environmental gradients due to variation in habitat structure and the functional composition of the fauna. Historical biogeography determines the evolutionary origin of the fauna, and this can strongly influence its adaptive capacity in relation to environmental stress and disturbance. Gabi has completed the processing and identification of samples from 41 sites varying in grazing intensity at Lakefield Station on the Sturt Plateau (medium rainfall), and is now working on samples from 80 sites at Old Man Plains and Henbury Stations near Alice Springs (low rainfall), using distance from water as a surrogate of grazing intensity. In September Gabi surveyed ants at 36 sites varying in grazing intensity at Annaburoo Station east of Darwin (high rainfall). Gabi is supervised by Prof Andersen, Charles Darwin University's Associate Professor Samantha Setterfield and Prof Inara Leal From Universidade Federal de Pernambuco, Brazil.
- Joint Charles Darwin University/ Australian National University student Stef Oberprieler commenced her PhD project on spatial patterns of invertebrate biodiversity under the supervision of Prof Andersen, Dr Keith McGuinness (CDU) and Prof Craig Moritz (ANU), based in TERC's ant biodiversity lab. Her project will explore invertebrate diversity and distribution in Kakadu and Nitmiluk National Parks, within the context of diversity and endemism in monsoonal Australia. Its specific aims are to: (1) evaluate the biogeographic patterns of invertebrate biodiversity (species richness, composition and phylogenetic diversity) within Kakadu/Nitmiluk National Parks, with particular reference to centres of diversity and endemism; (2) determine the biogeographic significance of the Kakadu/Nitmiluk fauna in the broader context of monsoonal Australia; (3) assess the major environmental drivers (e.g. soils, vegetation, rainfall, fire) that shape spatial patterns of invertebrate biodiversity; (4) analyse the extent to which historical biogeographic processes have influenced contemporary patterns of invertebrate biodiversity, and how

this varies with dispersal ability; (5) determine the congruence of spatial patterns of invertebrate and vertebrate biodiversity; and (6) identify which invertebrate groups optimally represent spatial patterns of overall invertebrate biodiversity, in the context of ongoing biodiversity assessment and monitoring.

- Professor Andersen hosted ant students, Julio Chaul from the Federal University of Vicosa, Minas Gerais, Brazil for seven months and Michael Greve from the Johannes Gutenberg Universitaet Mainz in Germany for two months.
- Brazilian PhD student Ms Keila Laste commenced a six-month visit to collaborate on the analysis and write-up of her work on ant responses to land use and ecosystem restoration in Brazilian Cerrado. Keila is supervised by Prof Giselda Durigan from Sao Paulo State University.
- US Fulbright scholar Israel Del Toro from University of Amherst visited the ant biodiversity lab for six months to work with Prof Alan Andersen on savanna ant species distributions in relation to climate change. Israel sampled ant distribution along the North Australian Tropical Transect, and combined the results with specimen data in the TERC ant collection to develop ant species distribution models as a basis for predicting ant responses to climate change. This research contributed to the Terrestrial Environmental Research Network (TERN). Dr Del Toro collaborated with Alan on a preliminary paper describing ant distributions along NATT based on previous work, which has been submitted for publication in *Journal of Biogeography*.
- The processing of ants sampled at >40 sites each along the TREND transect in South Australia and in the Great Western Woodlands of SW Western Australia was completed. These projects form part of CSIRO's contribution to the Terrestrial Environmental Research Network. A paper describing the GWW results has been accepted for publication in *Forest Ecology and Management*.
- Prof Andersen and Dr Hoffmann were collaborators on a range of projects using genetic analysis to explore diversity and phylogenetic relationships in selected ant genera. This included analyses of the genera *Odontomachus* (in collaboration with Dr Andy Suarez from University



PHOTO: © CRAIG NIEMINSKI

of Illinois) and *Rhytidoponera* (in collaboration with Prof Chris Austin from Monash University), and publication of a paper on the phylogeography of *maculatus*-like species in the cosmopolitan genus *Camponotus* (in collaboration with Dr Ronald Clouse from University of North Carolina).

- Dr Hoffmann was senior author of a paper describing a new species of *Polyrhachis*, *P. kohouti*, in honour of *Polyrhachis* specialist Mr Rudy Kohout from the Queensland Museum, who is a regular visitor to the ant biodiversity lab.
- Two papers from Dr Laura Leal's PhD thesis on seed dispersal by ants in Brazilian Caatinga were published in *Oecologia*, with Prof Andersen a co-author. Dr Leal's project was supervised by Prof Inara Leal from Universidade Federal de Pernambuco, and in 2013 she spent six months in the ant biodiversity lab writing the papers. Prof Leal, Dr Leal and Prof Andersen also submitted a paper on the relationship between plant stature and the incidence of myrmecochory (seed dispersal by ants), which was accepted for publication in *Biotropica*.
- Dr Hoffmann supervised three industrial trainee projects on north Australian ant-related research including:
  - the biology of Andersen's furnace ant (*Melophorus anderseni*);
  - quantifying potential island biogeography patterns of ants living at tree bases within flooded rainforests during the wet season; and
  - community comparisons of ant communities in adjacent savanna and floodplain habitats across northern Australia.



# Universidade Federal de Pernambuco and CSIRO

Prof Andersen visited Brazil for four weeks during May and June 2014 as part of a Brazilian-funded collaboration with Prof Inara Leal from Universidade Federal de Pernambuco, focussing on ant-plant interactions in semi-arid Caatinga. The primary purpose of his visit was to help teach an undergraduate field course in Catimbau National Park, and to collaborate on a range of PhD student projects on ant diversity and ant-plant interactions. He also visited ant ecologist Dr Fabricio Baccaro in the Amazonian city of Manaus.



Prof Andersen with Prof Inara Leal and Dr Xavi Arnan in a tropical dry forest in Catimbau National Park in northeastern Brazil. Dr Arnan had two postdoctoral visits to Prof Andersen's ant biodiversity lab, and is now part of Prof Leal's team.



Michael Greve

Niche differentiation and functional diversity of ants in an Australian rainforest was the focus of a research project undertaken by German Masters student, Michael Grevé from Johannes Gutenberg-University Mainz. Michael's project was based at Holmes Jungle in outer Darwin and used a bait-based sampling method to document competitive dynamics and niche differentiation in diet, time and space. The baits reflected the natural range of potential food resources as closely as possible and included sucrose, melezitose, seeds, crushed insects, live mealworms, live termites and bird faeces. The study found relatively low functional diversity and limited niche differentiation. This can be attributed to the environmental features of Holmes Jungle: a small and isolated patch of forest that is seasonally flooded.

Green tree ants (*Oecophylla smaragdina*)  
PHOTO: © ALEX WILD



## Revising the ant genus *Strumigenys*

Among the many Australian ant genera, *Strumigenys* is especially interesting because of its bizarre morphology and highly specialised diets. It is a huge genus, with more than 900 species described worldwide. The Australian fauna includes two endemic species groups (the *emmae* and *anderseni* groups), and under the supervision of Prof Andersen these were the subject of taxonomic revisions by Julio Chaul from the Federal University of Vicosa in Brazil, as part of his internship with CSIRO in Darwin. Julio examined the Tropical Ecosystems Research Centre's comprehensive ant collection as well as specimens from the South Australian Museum, the Queensland Museum and the Australian National Insect Collection. Distribution maps, identification keys, high resolution images and descriptions of the 13 new species were completed. Two of the new species in the *emmae* group appear to be workerless social parasites, depending on host colonies of other species. This is the first record of social parasitism in *Strumigenys*. In addition to his revisions of the *emmae* and *anderseni* groups, Julio recognised two new groups of species for Australia, one shared with South-East Asia and the other endemic to Arnhem Land in the Northern Territory, representing an entirely new lineage in the genus.



One of the new species of *Strumigenys* identified by Julio Chaul.



Julio Chaul collecting ants at the CSIRO site

## 2.2 Pest ant ecology and management

**Contact: Dr Ben Hoffmann**

Introduced pest ants are some of the greatest environmental and economic threats to northern Australia. The four most serious pest ant species occurring in the north are:

- Yellow crazy ant (*Anoplolepis gracilipes*)
- Tropical fire ant (*Solenopsis geminata*)
- African big-headed ant (*Pheidole megacephala*)
- Little fire ant (*Wasmannia auropunctata*)

All of these species are major pests throughout the world. Our research, which is part of CSIRO's Biosecurity Flagship, aims to understand the factors promoting invasion, to document the impacts of invasive ants on native biodiversity and ecological function, and to develop effective management strategies. CSIRO is collaborating with many local and regional organisations to effectively manage invasive ant incursions, especially on Indigenous lands, throughout the world.




**Yellow Crazy ant with worker cocoons.**

PHOTO: © ALEX WILD

### ACHIEVEMENTS IN 2014

- The Yellow Crazy Ant Management Project, a collaboration between Dhimurru Aboriginal Corporation, CSIRO and Rio Tinto Alcan Gove in north-east Arnhem Land, completed 2014 on-ground works on schedule. Yellow crazy ants have been eradicated from 24 sites, accounting for almost a quarter of all Yellow crazy ant eradications globally.
- Dr Ben Hoffmann published, or submitted for publication, papers on:
  - How human-mediated invasions and natural colonisations are identical from a scientific perspective.
  - How climate regulates the effects of anthropogenic disturbance on ant community structure.
  - Climate change predictions within the world's 35th Biodiversity hotspot
  - How biology is an important component of ant eradications.
  - How body size has changed in different geographic regions of a invasive species' global distribution.
- Climate change predictions of distributions of 15 of the world's worst invasive ants.
- How sea-level rise needs to become a consideration for eradications on islands.
- Supercolony traits of the Yellow crazy ant.
- Dr Hoffmann was an invited speaker at the Entomological Society of America conference, Portland, Oregon, USA, where he presented a talk about advances in invasive ant management over the past 30 years and future prospects. He was also an invited speaker at the Association for Tropic Biology Conference, Cairns, Australia, where he presented a talk about advances in invasive ant management over the past 30 years and future prospects
- Dr Hoffmann supervised an industrial trainee project on non-target effects of Yellow crazy ant treatments in north-east Arnhem Land.
- He also provided ongoing supervision of PhD student, Meghan Cooling, from Victoria University in Wellington, New Zealand, who is investigating the mechanism of population declines in some Yellow crazy ant infestations in north-east Arnhem Land.
- French post-doctoral researcher, Laurence Berville, joined the Darwin laboratory to work on a project investigating the effects of nutrition on invasive traits in ants.
- Dr Hoffmann hosted Distinguished Visiting Scientist, Associate Professor Andy Suarez, from the University of Illinois. Andy was based in Darwin for six months and worked on a range of invasive ant projects investigating the biology, ecology, and mechanisms of ant invasions.





While in Darwin, Professor Andy Suarez's research focused on the invasion genetics of the Tropical fire ant (*Solenopsis geminata*).

PHOTO: © ALEX WILD

## CSIRO distinguished visiting scientist

by Professor Andy Suarez

Director, Program in Ecology, Evolution, and Conservation Biology  
University of Illinois, USA

One thing all academics look forward to is taking a sabbatical. In 2014, I spent six months in Australia with Dr Ben Hoffmann in Darwin as part of CSIRO's Distinguished Visiting Scientist Scheme. I could not have picked a better place; Alan Andersen and Ben Hoffmann are experts in Australian ant ecology, particularly in relation to ecosystem function and biological invasions. The goals of my sabbatical were to start new collaborations between our labs and get back into the field and conduct some research.

The trip was remarkably successful from an academic perspective. Our primary research project focused on the invasion genetics of the Tropical fire ant (*Solenopsis geminata*). This species originates from Mexico but has spread nearly worldwide, including much of Australia. We also performed a series of behavioural experiments to examine why some ant species are more resistant to invasions than others. This work was conducted in north-east Arnhem Land and focused on the Yellow crazy ant (*Anoplolepis gracilipes*). Ben's primary goal is to eradicate this species and monitor the recovery of the native community.

The trip also provided opportunities for members of my team to get involved in collaborative projects in Australia. Bill Wills, Ben and I have a paper in press on morphological variation among populations of the invasive African big-headed ant (*Pheidole megacephala*).

Adrian Smith is analysing the cuticular hydrocarbon profiles of furnace ants (*Melophorus anderseni*) to determine how they can successfully parasitize colonies of meat ants (*Iridomyrmex* spp.). This work is being done in collaboration with an undergraduate student working in Darwin from Associate Professor Terry McGlynn's laboratory at California State University in Dominguez Hills. Finally, Fred Larabee is sequencing Australian trap jaw ants in the genera *Odontomachus* and *Anochetus* to help resolve species boundaries in Australian species.

In addition to working in Darwin, I presented seminars at Universities and CSIRO laboratories in Canberra, Adelaide and Cairns. I ended my Australian adventure by attending the International Union for the Study of Social Insects 17th Congress in Cairns.

It is hard to describe how awesome this trip was (with one exception – passing a kidney stone - thanks Ben for getting to me to the doctor that day!). The Australian wildlife is unlike anywhere else and we saw saltwater crocodiles, wallabies, blue-tongued skinks, and more birds than we could keep track of.



Professor Andy Suarez (left) from the University of Illinois spent 6 months in the invertebrate biodiversity lab in Darwin in 2014. He was hosted by Dr Ben Hoffmann (right).



# Invasive ants causing havoc on the Galapagos Islands

When you think of the Galapagos Islands, invasive ants are not the first creatures that spring to mind. The Galapagos Islands, famous for their remarkable plants, reptiles and birds that are not found anywhere else on the planet, are under threat from increasing numbers of invasive ants. Tropical fire ants, *Solenopsis geminata* are killing some of the most famous and threatened species on the Galapagos Islands, including hatchlings of Galapagos tortoises, marine iguanas, and a threatened sub-species of a Galapagos Mockingbird, of which there are only 30 individuals left alive.

At the invitation of the Charles Darwin Foundation, Dr Ben Hoffmann travelled to the Galapagos in June to provide expert advice on a range of invasive ant projects currently being undertaken on many of the Islands. Located on the equator west of Ecuador, the Galapagos Islands are renowned for their influential role in the development of Charles Darwin's theory of evolution by natural selection.

Ben provided management advice on three ant species – the Little fire ant *Wasmannia auropunctata*, which can be eradicated from some isolated islands but not from the Galapagos entirely; the Tropical fire ant *Solenopsis geminata*, which is too widespread for any eradication efforts, but must be controlled in breeding areas for some key species; and the African big-headed ant *Pheidole megacephala*, which is a recent arrival and may be a candidate for complete eradication from the archipelago.

According to Dr Hoffmann, a number of other highly invasive ant species are currently not found on the Galapagos Islands but are present on mainland Ecuador.

“These ants in Ecuador present a really high risk and we're aiming to address this problem by training local biosecurity staff in identification of ant species and providing specimens to the Galapagos museum,” he said.

One of the challenges of controlling invasive ants on the Galapagos Islands is to avoid non-target impacts on endemic invertebrates, particularly land crabs, which are susceptible to ant-treatment products. The development of environmentally sensitive methodologies is the focus of current research.



CSIRO's Ben Hoffmann at the Charles Darwin Foundation's Insect Containment Facility on the Galapagos Islands.



Tropical fire ants, *Solenopsis geminata*, are killing Galapagos tortoise hatchlings in their underground nests.

PHOTO: © ALEX WILD



## 2.3 Ants as bioindicators

Contact: Dr Alan Andersen

Ants are widely used as bio-indicators in land management because of their high diversity, great ecological importance, sensitivity to environmental change, and ease of sampling. Our research aims to improve our understanding of how ant communities respond to land management, the extent to which these responses reflect broader ecological change, and how ant monitoring is most effectively applied to environmental management.

### ACHIEVEMENTS IN 2014

- Sampling of ants was completed at 59 sites in the Mitchell region as part of a project looking at the effects of fire on ant diversity in the poplar box landscapes of south-eastern Queensland. The project is part of the Gas Industry Social and Environmental Research Alliance, and has collaborators from the Queensland Herbarium and the Queensland Murray-Darling Committee.
- Ants were included in a biodiversity survey of rehabilitated minesites and surrounding reference sites on Groote Eylandt, as part of a project commissioned by GEMCO and led by Cumberland Ecology. Ant samples from 15 rehabilitated and 10 reference sites were sent to CSIRO for processing and analysis. Results indicated that a lack of fire at rehabilitated sites is limiting their ecological convergence with reference sites.



## 3 Indigenous natural resource management

Across Australia, Indigenous people are increasingly involved in land and resource management in an effort to integrate Indigenous rights and interests into policy and program management, and contribute ecological knowledge to solving environmental problems. Indigenous community-based natural resource management is now one of the fastest growing sectors in Australia's environmental management system.

In northern Australia, Indigenous people have a major part to play in the sustainable management of the region's terrestrial, freshwater and marine ecosystems. Their stake derives from the very large size of the northern land base under Indigenous ownership and management; the religious beliefs that underpin customary attachment to land; and a body of environmental knowledge accumulated over hundreds of generations of actively caring for country. CSIRO is engaged in strong partnerships with a number of indigenous communities in the NT and other parts of the north. In these project collaborations that span research topics as diverse as fire management, aquatic conservation, and marine planning, researchers, Land Councils, local Aboriginal Ranger groups and government partners are exchanging knowledge and developing innovative solutions to identified environmental problems.

### 3.1 Impacts of climate change on Indigenous communities in Kakadu National Park

**Contact: Prof Alan Andersen**

CSIRO is collaborating with researchers from CDU to undertake an assessment of the impacts of climate change and weed infestations on the floodplain environments and Indigenous communities of Kakadu National Park. PhD student Emma Ligtermoet is working with Traditional owners from Kakadu and Gunbalanya in western Arnhem Land, on a project about customary freshwater resource use, the past, present and future factors affecting harvesting practices and adaptive strategies.







## ACHIEVEMENTS IN 2014

- Emma Ligtermoet completed her third year of field work, which focused on floodplain management preferences and future aspirations for sustaining customary harvesting opportunities.
- A presentation on Aboriginal responses to environmental change and drivers of adaptive capacity in the floodplains of the Kakadu National Park was given at the IUCN World Parks Congress in Sydney in November, as part of a session on climate change adaptation and cultural heritage
- Consultations with senior women from Gunbalanya in west Arnhem Land, adjacent to Kakadu National Park took place to create a Kunwinjku seasonal calendar of traditional ecological knowledge. This calendar will be completed in early 2015.



Gunbalanya traditional owner Julie Narndal (right) working with Lois and Donna Nadjamerreck from Gunbalanya, on a Kunwinjku seasonal calendar.



Traditional owners Annie Ngalmirama and Nida Mangranbarr point out changes to a fishing place they used to frequent in Kakadu National Park.





PHOTO: © TOURISM NT

## 3.2 Top end marine and multiple use management

**Contact: Prof Alan Andersen**

There are many, often competing, interests in Australia's marine and coastal regions, where the sustainable use and management of the marine environment is a national priority. The marine environment of the Northern Territory (NT) is relatively unspoilt, and there are competing interests among mining, fishing, Indigenous and conservation sectors. Existing models of marine multiple use management include one or more aspects such as integrated conservation and development planning maps, frameworks for prioritising multi-stakeholder interests and values, and collaborative arrangements for decision-making. However, there is currently no overarching framework that integrates the different aspects of marine multiple use management to facilitate its effective implementation. Instead, marine multiple use management has often been undertaken on a case by case basis. An initial scoping exercise has aimed to identify key stakeholders, research priorities and knowledge gaps, as well as potential projects and collaborators, for coastal and marine management in the NT.

### ACHIEVEMENTS IN 2014

- A paper examining stakeholders' readiness for more strategic approaches to coastal and marine management in the NT, led by Claire Mason from CSIRO's Land and Water Flagship, was published in *Ocean & Coastal Management*.
- Prof Andersen attended the inaugural meeting of the new Advisory Committee for the expanded Dhimurru Indigenous Protected Area (IPA). Dhimurru Aboriginal Corporation manages one of the oldest IPAs in Australia, initially covering about 100 square kilometres of the Gove Peninsula in north-east Arnhem Land in the Northern Territory. It now includes an extra 450 square kilometres of sea country.
- In partnership with the Dhimurru Aboriginal Corporation, Prof Andersen collaborated with colleagues from CSIRO's Oceans and Atmosphere Flagship to develop a research proposal for scoping an Indigenous rock lobster industry on the Gove Peninsula. This drew on CSIRO's long-standing research on rock lobsters in partnership with Indigenous communities in the Torres Strait.

## 3.3 Dhimurru fire and biodiversity monitoring project

**Contact: Prof Alan Andersen**

The wise use and management of terrestrial resources provides opportunities for Indigenous people to live on country, practice customary activities and strengthen their culture. This partnership between Dhimurru Aboriginal Corporation and CSIRO is establishing a biodiversity monitoring programme in relation to fire within the Dhimurru Indigenous Protected Area (IPA). The project is funded by the Australian Government's Department of Environment Biodiversity Fund. The project has established about 30 long-term biodiversity monitoring sites within different vegetation types, and with a particular focus on understanding biodiversity patterns and trends in relation to fire. Woody plants, reptiles, birds, ants and mammals are being surveyed at the sites using standard biodiversity survey protocols for the NT. It is also identifying Yolngu cultural burning priorities and promoting increased community participation in Dhimurru fire management for biodiversity conservation benefits. A series of workshops, co-ordinated by Dhimurru Aboriginal Corporation, will be held with Yolngu Traditional Landowners to develop a vision for fire and biodiversity management within the IPA.

### ACHIEVEMENTS IN 2014

- Initial biodiversity surveys were conducted in late 2013, and are planned to be repeated in 2016.





PHOTO: © TOURISM NT

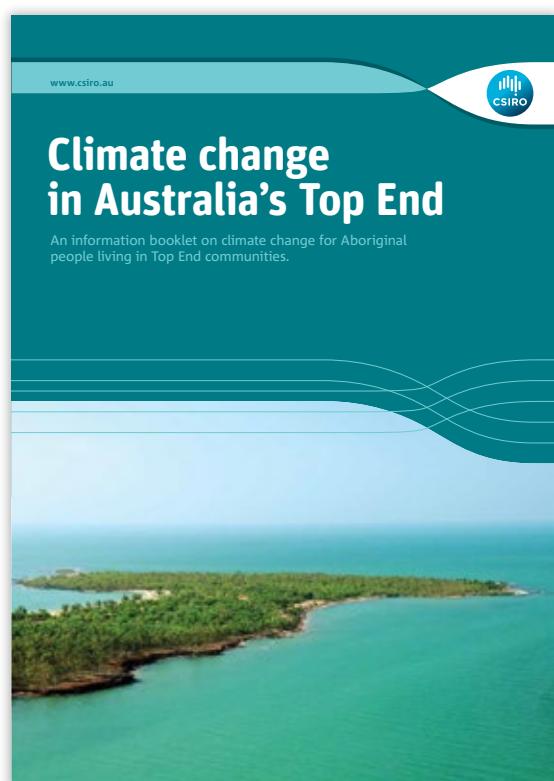
## 3.4 Engaging Indigenous communities in climate-change science on the Tiwi Islands

**Contact: Ms Barbara McKaige**

Remote Indigenous communities represent Australia's most disadvantaged sector in terms of engagement with science. With strong socio-cultural ties to ancestral lands, habitats and wildlife, and with livelihoods that are highly dependent on natural

resources, Indigenous communities also represent one of Australia's most sensitive sectors in terms of impacts of climate change. This Inspiring Australia-funded project used climate change and climate adaptation as a focus for increasing engagement with science in Indigenous communities on the Tiwi Islands. In partnership with the

Tiwi Land Council and Tiwi College, a range of educational activities and culturally appropriate communication materials were developed to explain climate change science, and provide the basis for discussion about the regional implications for Tiwi communities.



The Climate Change Information Booklet was compiled with information and examples of direct relevance to Aboriginal communities in northern Australia. It was reviewed by CSIRO climate scientists, climate science communicators, Aboriginal educators and the Tiwi Land Council.

### ACHIEVEMENTS IN 2014

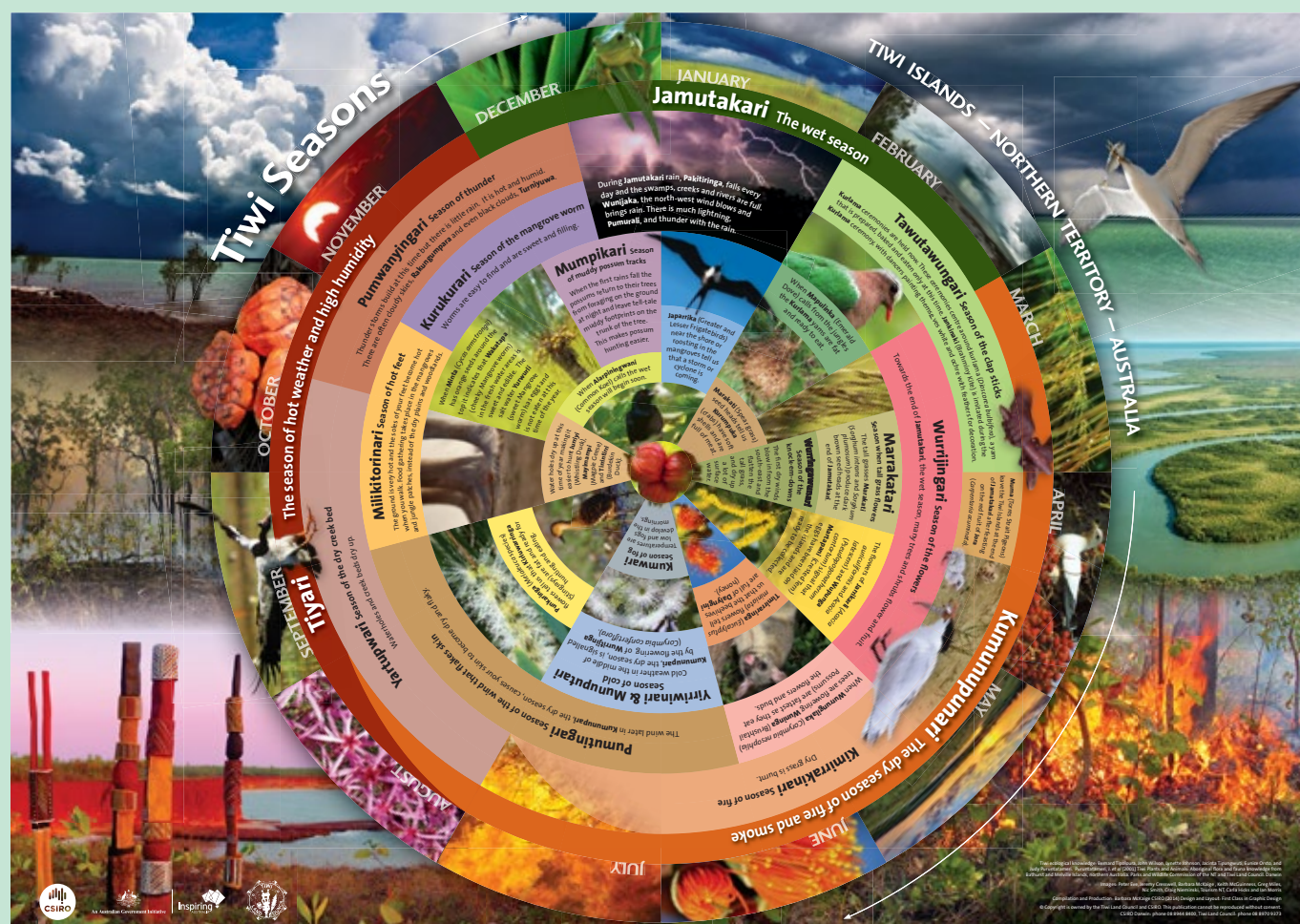
- A plain-English information booklet on climate change for Indigenous communities was developed and distributed to Aboriginal communities via Aboriginal Land Councils, Aboriginal community shires and councils, local libraries and remote and urban schools across the Top End.
- A program of vegetation monitoring targeting key Tiwi plant and bush tucker species was undertaken by Tiwi College students with mentoring from the Tiwi Land Rangers.
- In collaboration with senior Tiwi Traditional Owners, two Tiwi information calendars were produced: one calendar focused on Tiwi seasons and the environmental cues, while the other focused on plants and animals of particular significance to Tiwi people.



# Tiwi calendars

PHOTO: © PETER EVE

## TIWI SEASONS



Many Tiwi people are concerned about losing ecological knowledge once holders of this knowledge pass away. With fewer opportunities for older and younger people to spend time on country, this contextually-specific information about seasonal resource use isn't being passed on as it once was. In collaboration with senior Tiwi Traditional Owners, CSIRO produced two Tiwi information calendars: one calendar focused on the three main and 13 minor Tiwi seasons and environmental cues, while the other focused on plants and

animals of particular significance to Tiwi people. The highly visual calendars will be used both as an educational tool in schools across the Tiwi Islands, and to engage young Tiwi people in less-formal settings.

The information contained in the calendars is underpinned by the annual seasonal cycle, with resource collection activities occurring sequentially throughout the year. The exact timing of different events depends on the lengths of the flowering and breeding

seasons, which in turn is dictated by climatic events. Any changes to the climate will have an impact on the flowering and breeding cycles of the plants and animals depicted within the Tiwi Calendars. In effect, the Tiwi Seasons Calendar and the Tiwi Plants and Animals Calendar both provide a baseline from which future ecological change, and resource use patterns by Tiwi Islanders, can be broadly measured.



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## 4 Rangeland ecology and management

Rangelands cover approximately 85% of the Australian continent. In northern Australia the rangelands extend from the tropical and sub-tropical savannas in the north and east to the more arid areas in the central and western regions. The northern rangelands have a multiplicity of potential uses and support a variety of economic activities and communities. Extensive livestock (mainly cattle) grazing has been the dominant land use for decades and continues to be so. However, with tougher terms of trade there is increasing interest in the economic opportunities offered by new natural resource-based activities.

For example, recently there has been much speculation that the northern rangelands have the potential to store significant amounts of carbon and this could help Australia meet its greenhouse gas emissions targets. Over recent years our research has focussed primarily on two issues in the grazed northern rangelands – future development opportunities for the northern beef industry and the potential for increasing carbon sequestration in the rangelands.



### 4.1 Development opportunities for the northern beef industry

**Contact: Dr Garry Cook**

This project explored alternative development pathways for the northern beef industry and associated research and developments needs for the next 10 to 20 years. The project received funding from Meat and Livestock Australia and involved several CSIRO and external collaborators. It was co-led by Drs Andrew Ash and Leigh Hunt. Alternative development scenarios (identified with assistance from people in the northern beef industry) that offer potential to significantly improve productivity in the industry were identified. Development scenarios included the use of improved pastures, the use of small-scale high production irrigated forages, improvements in rumen ecology, and genetic improvements in cattle growth and reproductive performance. The scenarios were evaluated for their likely production, financial and environmental effects with the help of a systems model of northern beef enterprises, built specifically for this purpose.

#### ACHIEVEMENTS IN 2014

- Dr Hunt canvassed a range of approaches for boosting productivity and profitability of northern beef enterprises in a published paper and a report to Meat and Livestock Australia. These publications showed that key opportunities with potential for improving profitability in the northern beef industry are associated with improving cattle growth and reproduction through genetic developments, rumen modification to improve feed efficiency and improving cattle nutrition/supplementation (and reducing the cost).
- In three published papers, Dr Hunt and partners explored sustainable grazing land management with a focus on temporal and spatial variability and on the use of fire.





## 4.2 Carbon in the northern rangelands

**Contact: Dr Garry Cook**

Despite their generally low and unpredictable levels of productivity, the vast area of Australia's rangelands may represent a nationally important carbon sink, and offer the opportunity for land holders to earn carbon credits through management that increases carbon sequestration. Even if the opportunities for carbon sequestration in the rangelands are low, it is important that land use should not unduly contribute to greenhouse gas emissions. However, there are presently insufficient data to support carbon accounting in Australia's rangelands or to understand the effects of management options on carbon rangeland dynamics.

### ACHIEVEMENTS IN 2014

- Work continued on a project that is testing the utility of a state-and-transition framework of ecological condition in understanding and predicting changes in carbon stocks in the rangelands. Final sampling was undertaken on black-soil treeless plains at Helen Springs Station on the Barkly Tablelands in the Northern Territory. This field work involved the collection of soil samples for carbon and nitrogen analysis. The team also cut down and weighed rubber bush (*Calotropis procera*) plants of various sizes, allowing relationships to be developed between stem diameter, height and biomass (or carbon content).
- In a study of the relationship between grazing land management and carbon sequestration in rangelands, Dr Hunt and colleagues concluded that the opportunities for pastoralists to increase carbon stocks will depend on the frequency of fire and vegetation type (especially its woodiness or potential woodiness). Reducing fire frequency in woody rangelands will increase carbon stocks, but may have adverse effects on pasture

and livestock production. Reducing grazing pressure or destocking might also increase carbon stocks but may be relevant only when a property is overstocked or where relatively unproductive land could be taken out of livestock production. Any carbon gains from altering fire and grazing management are likely to be modest.



Collecting biomass samples on Helen Springs Station were French intern Alice Delude, Sam Walker and Leigh Hunt.



The Helen Springs team included, from left, Leigh Hunt, Adam Liedloff, French intern Alice Delude, Gary Bastin, Sam Walker and French intern, Justine Boussier.



## Grassland biodiversity and productivity: NutNet at Kidman Springs

In April, June and November, Drs Anna Richards, Leigh Hunt and Garry Cook established a grassland biodiversity and productivity experiment at the Victoria River Research Station (Kidman Springs), which is managed and funded by the NT Department of Business, Industry and Resource Development in the Victoria River District. The experiment forms part of a global study called the “Nutrient Network” (NutNet) and joins more than 70 sites that have been established in identical fashion across the globe, including several sites in Australia. The global NutNet research cooperative aims to answer crucial ecological questions including:

1. How general is our current understanding of productivity-diversity relationships?
2. To what extent are plant production and diversity co-limited by multiple nutrients in herbaceous-dominated communities?
3. Under what conditions do grazers or fertilization control plant biomass, diversity, and composition?

The Kidman Springs site is located in a long-term grazing exclosure, and consists of 10 nutrient x herbivore exclusion treatments replicated across three blocks. In addition to the standard NutNet design, three extra blocks were established outside the grazing exclosure to study the interaction between domestic grazing and nutrients on grass diversity and productivity.



**Dr Anna Richards installing a fence to exclude cattle from one of the NutNet treatments.**



**Dr Leigh Hunt was part of the team that established the NutNet experiment at Kidman Springs.**



**Sam Walker collecting vegetation data.**



## Gamba grass and savanna carbon

Gamba grass (*Andropogon gayanus* Kunth.) is regarded as one of Australia's worst weeds because of its invasiveness, potential for spread, and economic and environmental impacts. A key impact of gamba grass invasion is elevated fuel loads leading to more severe fires which have been shown to cause major death of trees and shrubs and increased carbon emissions. CSIRO collaborated on a National Environmental Research Program project on gamba grass led by Associate Professor Samantha Setterfield from Charles Darwin University. The project aims to determine changes in plant biodiversity and carbon stocks, both above- and below-ground, with increasing levels of gamba grass invasion in tropical savanna in the NT. The project will investigate changes at a range of sites with different dominant savanna vegetation. These data will be integrated in a decision-support tool that will be used to guide the most cost-effective management of gamba grass at a regional scale.

**TOP: CSIRO's Jon Schatz preparing to do ground cover assessments to accompany soil data collected at gamba grass sites at Batchelor**

**BOTTOM: CSIRO's Jon Schatz and CDU's Associate Professor Dr Sam Setterfield collect a soil core for dissection and analysis of carbon and nutrient content at various depths.**



# Awards

## CSIRO Chief Executive study award

In 2014, Emma Woodward received a Chief Executive's study award to visit Canada to learn more about Indigenous research engagement and contribute to CSIRO's Indigenous Engagement Strategy. Emma met with many Indigenous and non-Indigenous research partners to identify factors that contribute to successful cross-cultural partnerships. She also sought out successful and innovative ways in which research institutions are creating opportunities for Indigenous involvement in science and research. Emma was hosted by Prof Fikret Berkes at the Natural Resources Institute, University of Manitoba, and by Prof Nancy Turner at the University of Victoria. Emma was invited by Nancy to travel to Gitwinksihlkw, a Nisga'a First Nations community in the Nass Valley in the far north of British Columbia, where she contributed to an intensive ethnobotany course. This was a highlight of the Award for Emma, and a particularly insightful part of her travels. Gitwinksihlkw is a small community in a relatively remote location, which has not prevented the community from hosting a satellite campus of the University of Northern British Columbia. This creates accessible opportunities for First Nations and other students to undertake courses and obtain further education that would otherwise be very difficult to attain. Emma's travels to Canada firmly reminded her of the importance of making oneself aware of past Indigenous experiences with research (and government relations more broadly) when seeking to foster new Indigenous-non-Indigenous research partnerships and relationships.



Emma Woodward (centre) with Nancy Mackin and Prof Nancy Turner.



Emma Woodward contributed to an intensive ethnobotany course at Gitwinksihlkw, a Nisga'a First Nations community in the Nass Valley in the far north of British Columbia.



# Our people

## Staff

### Scientific staff

**Prof Alan Andersen** (Team Leader; ant community ecology, fire ecology)

**Dr Garry Cook** (Team Leader, savanna vegetation and carbon dynamics)

**Dr Ben Hoffmann** (ant ecology)

**Dr Leigh Hunt** (rangeland ecology)

**Dr Adam Liedloff** (ecological modelling)

**Dr Anna Richards** (soil and carbon ecology)

**Ms Emma Woodward**  
(Indigenous livelihoods)

### Technical support

**Ms Sarah Bonney** (invertebrate ecology)

**Ms Harriet Eeley** (soil and carbon ecology)

**Ms Jodie Hayward** (invertebrate ecology)

**Ms Magen Pettit** (invertebrate ecology)

**Mr Jon Schatz** (vegetation/fire/pest ant ecology)

**Ms Samantha Walker** (soil and carbon ecology, invertebrate ecology)

### Research support

**Ms Lesley Dias** (CSIRO Information Management & Technology - Librarian)

**Ms Ellie Kosta** (Reception and Administration Support)

**Ms Barbara McKaige** (Research Projects Coordinator and Support)

**Ms Vicki O'Loughlin** (Health Safety & Environment and Administrative Support)

**Ms Sarah Bonney** (Health Safety & Environment and Administrative Support)

**Mr Brian Tippet** (CSIRO Information Management & Technology – IT support)

### Graduate students on-site

**Ms Gabriela Arcoverde**, Charles Darwin University (ant responses to grazing)

**Ms Emma Ligtermoet**, Australian National University (Indigenous use of floodplain resources: implications for climate change adaptation)

**Ms Stefanie Oberprieler**, Charles Darwin University (invertebrate biodiversity)

### Research fellows

**Mr Tony Hertog** (invertebrates/wildlife surveys)

**Dr Dick Williams** (vegetation, fire and alpine ecology)





## 15 years with CSIRO

Ecological modeller, Dr Adam Liedloff and Invertebrate biodiversity technical officer, Magen Pettit, both celebrated 15 years of service with CSIRO in 2014.



## Great Cycle Challenge

In October, Magen Pettit participated in the Great Cycle Challenge, a national event which encourages riders to set their own personal cycling challenge and raise funds towards research into treatments and a cure for childhood cancer. While undergoing chemotherapy for her own breast cancer, Magen cycled 104.4km to fight kids' cancer and raised \$1467 giving her a national ranking of 279th and 13th in the NT.



Since joining CSIRO in 1999 Dr Adam Liedloff's research has centred around fire and landscape modelling in northern Australia. A model he helped develop called *Flames* is being used to explore the dynamics of landscapes across northern Australia to determine the impacts of land management and fire, and to better understand carbon dynamics.



Magen Pettit, pictured collecting ants on the Tiwi Islands, provides senior technical support for Darwin's ant biodiversity research, which covers systematics, biogeography and community ecology. Magen joined CSIRO Entomology in 1999 to work on the biological control of the weed, *Mimosa pigra*. She transferred to Sustainable Ecosystems (now Land and Water Flagship) in 2004.



# Students

## GRADUATE STUDENTS SUPERVISED BY CSIRO DARWIN STAFF

STUDENT	DEGREE	UNIVERSITY	TOPIC	CSIRO SUPERVISOR
Gabriela Burle Arcoverde	PhD	Charles Darwin University	Biogeographically contingent impacts of disturbance: Resilience of savanna ant communities in relation to grazing in Australia and Brazil	Prof Andersen
James Camac	PhD	University of Melbourne	Climate change and alpine fire regimes	Dr Williams
Meghan Cooling	PhD	Victoria University of Wellington, New Zealand	Factors influencing natural decline of ant invasions	Dr Hoffmann
Joseph (Joey) Fasheh	Masters	California State University Dominguez Hills, USA	Interaction between minesite rehabilitation and an invasive ant	Dr Hoffmann
Michelle Freeman	PhD	University of Melbourne, VIC	Fire and vegetation dynamics on the Tiwi Islands	Drs Cook and Richards
Keila Laste	PhD	Sao Paulo State University, Brazil	Biodiversity responses to land use and ecosystem restoration in Brazilian Cerrado	Prof Andersen
Pauline Lenancker	Masters	Paris Natural History Museum, France	Sociogenetics of Tropical Fire Ant in Australia	Dr Hoffmann
Emma Ligtermoet	PhD	Australian National University	How do complex socio-ecological systems adapt to environmental change and how might this apply for climate change? A case study of Indigenous use of floodplain resources in the Alligator Rivers Region, NT	Prof Andersen
Sara Nowrouzi	PhD	James Cook University	Ant distribution in the wet tropics	Prof Andersen
Stefanie Oberprieler	PhD	Charles Darwin University		Prof Andersen
Kate Sparks	PhD	University of Adelaide	Systematics of Australian species of the ant genus <i>Monomorium</i>	Prof Andersen
Grant Staben	PhD	University of Tasmania	Cyclones and vegetation dynamics	Dr Cook
Parash Subedi	Masters	Charles Darwin University	Establishing a calibration between LiDAR data with ground based biomass data for northern Australian savannas & The influence of fire frequency and intensity on fine root turnover	Dr Richards



## STUDENT PROFILE

Yellow crazy ant (*Anoplolepis gracilipes*)  
PHOTO: © ALEX WILD

### by Joey Fasheh

My time here at CSIRO Darwin has been adventurous, educational, and world expanding. I came to the Northern Territory to do my Master of Science research, and to fulfil a lifelong goal of living in another country. CSIRO delivered on both fronts!

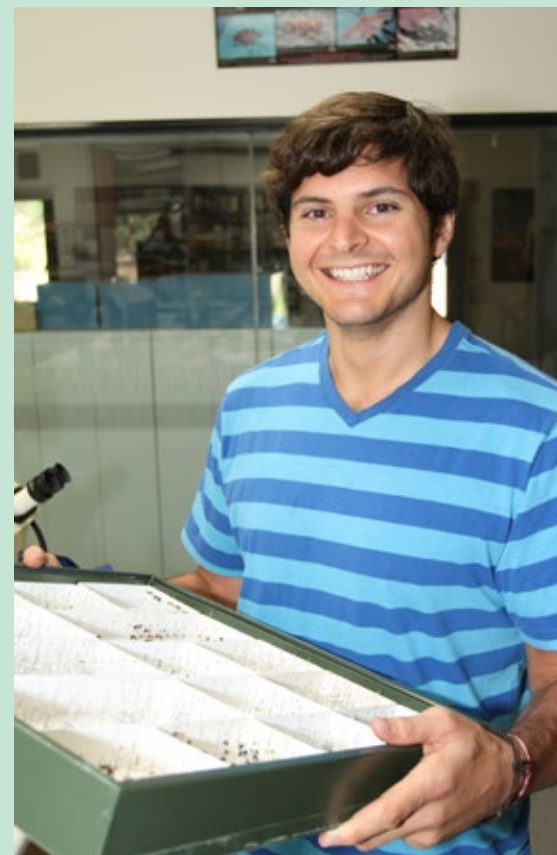
My research was centred on the recovery of mining sites in north-east Arnhem Land, specifically the Gove Aluminium mine site. The mine was established in the mid 1960s, and shortly thereafter the mine was expanded. As the mine grew the previously mined land was rehabilitated with the hope that it would recover to previously undisturbed levels. I worked on a research project that used ants to determine the effectiveness of the rehabilitation effort. In addition to the recovery from mining, an invasive ant species, Yellow crazy ant, *Anoplolepis gracilipes*, was found at several sites undergoing rehabilitation. The study also looked at the effectiveness of treatment of an invasive species and the subsequent recovery of the native ant fauna. Ants are good bioindicators as they are easy to sample, are abundant, diverse, and have several specialized niches in the ecosystem. A total of 15 sites were sampled from 2005 through 2011. The experimental sites had a wide range of rehabilitation age (5-39 years) yielding a broad spectrum of mining recovery.

Previous CSIRO students and staff made field trips to the Gove mine site to collect the ants. The specimens were collected using pitfall traps set up in a 3 x 5 grid with 10 m spacing. The ants were sorted and identified, and species abundance was recorded. A total of 131 native ant species were collected, representing nine subfamilies

and 34 genera. I analysed the raw data utilizing standard statistics, non-metric multidimensional scaling, and classifying species into functional groups designed by Professor Alan Andersen. I found that Yellow crazy ants are having a significant impact on minesite rehabilitation by eliminating most large native ants. Toxic treatments to eradicate Yellow crazy ants have minor non-target impacts, but within a year the rehabilitation process is what would be expected for a site that was not originally infested with Yellow crazy ants. The results fully support the environmental benefits of eradicating Yellow crazy ants from the Gove minesite, and I presented my findings in a seminar to staff and students at CSIRO in Darwin.

While living in the Top End, I was also able to take part in an amazing field trip to Kakadu National Park. A scientist from NT Parks and Wildlife Commission and I spent 8 days surveying vertebrate and invertebrate diversity in isolated parts of Kakadu. The survey areas were so isolated we had to be transported by helicopter. By day we set traps and took the required data points, finding time to explore the wonders of Kakadu's stone country. By night I found myself watching dynamic thunder storms, and camping in a cave complete with Aboriginal cave paintings. It was one of the most memorable experiences of my life.

Life at the CSIRO student house was memorable as well. The on-site property housed students from all around the world including: Australia, The United States, France, Brazil, Wales, and Hungary. The student house was conducive to forming lasting friendships as well as intelligent discussions



regarding our ongoing research projects. It provided the cultural diversity I was looking for in my living abroad experience.

I can't thank CSIRO and the staff in Darwin enough for my experience. Not only did I complete the research for my MS, but I gained valuable laboratory and life skills during my seven month stay. It is a chapter of my life that I will cherish forever.

## STUDENT TRAINEES

STUDENT	DATE	EDUCATIONAL INSTITUTION	CSIRO SUPERVISOR
Justine Boussier	March – August	AgroParis Tech University, France	Prof Andersen
Julio Chaul	January – July	Federal University of Vicosa, Minas Gerais, Brazil	Prof Andersen
Sophie Cross	February	University of Western Australia	Prof Andersen
Alexandre Cussonneau	January – February	AgroParis Tech University, France	Prof Andersen
Alice Delude	March – July	AgroParis Tech University, France	Prof Andersen
Michael Greve	October – December	Johannes Gutenberg Universitaet Mainz, Germany	Prof Andersen
Alexandre Harivel	September – December	Esitpa - Ecole d'ingénieurs en Agriculture, France	Dr Richards
Sara Hu	January – August	California State University Dominguez Hills, USA	Dr Hoffmann
Sebastien Laurent	September – December	Esitpa - Ecole d'ingénieurs en Agriculture, France	Dr Liedloff
Daisy Lippiatt	November – December	Charles Darwin University, NT	Dr Hoffmann
Julie Louvrier	January – February	Montpellier SupAgro, France	Prof Andersen
Zhixing Lu	October – December	Research Institute of Resources Insects, Chinese Academy of Forestry, China	Dr Hoffmann
Clemence Maillot	July – November	ENSAIA University, Nancy, France	Prof Andersen
Zsofia Palfi	March	Southern Cross University, Albury, NSW	Prof Andersen
Erica Parra	January – August	California State University Dominguez Hills, USA	Dr Hoffmann
Jaime (Abe) Perez	January – August	California State University Dominguez Hills, USA	Dr Hoffmann
Leo Simon	January – February	Montpellier SupAgro, France	Dr Richards
Jessica Stassi	November	Tiwi College, NT	Ms Hayward, Ms Pettit & Mr Schatz

## Tiwi College work experience student

In November, Tiwi College student Jessica Stassi completed work experience with CSIRO in Darwin. Jessica got a chance to learn about the Tiwi Carbon Study first hand. The Tiwi Carbon Study is partnership between the Tiwi Land Council, Tiwi Land Rangers, Tiwi Plantations Corporation, CSIRO and the Department of the

Environment. It aims to identify the biophysical and economic potential of fire management for greenhouse gas abatement on the Tiwi Islands, as a basis for possible livelihood opportunities for Tiwi people. Jessica processed soil samples from different fire plots for soil organic carbon analysis. This information will be

used to better understand how fire affects the amount of carbon stored in Tiwi soils. Jessica also measured Karntirrikani (Cypress Pine) trees for a project on water availability and tree growth, and worked in the invertebrate biodiversity laboratory.

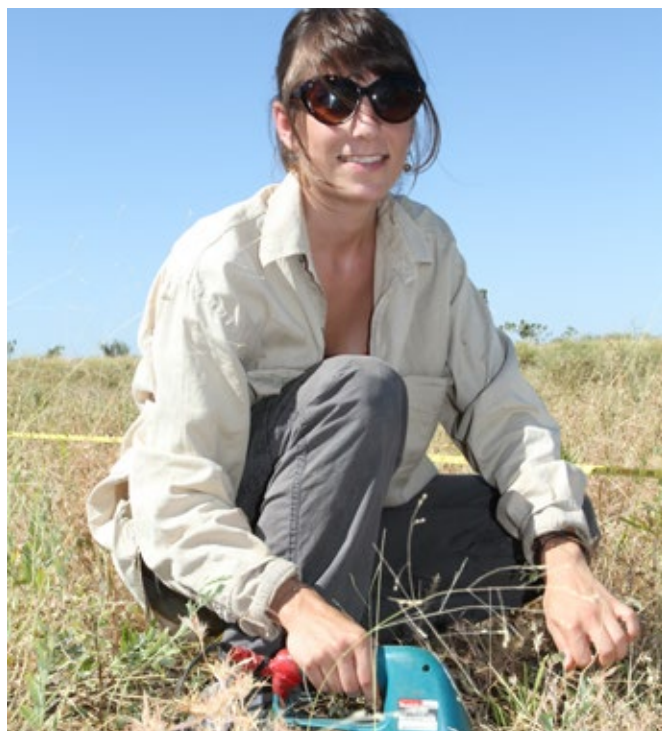




## 2014 DARWIN STUDENTS



French intern Justine Boussier from AgroParisTech in France was part of a team cutting down Rubber bush (*Calotropis procera*) on the Barkly Tablelands to assess carbon contents. Rubber bush, an introduced shrub, could be an important store of carbon across the rangelands



As part of a project on assessing carbon stocks in the rangelands, French intern Alice Delude from AgroParisTech in France clipped biomass samples from Helen Springs Station in the Barkly Tablelands.



An ongoing collaboration between CSIRO's Dr Ben Hoffmann and Associate Professor of Biology, Terry McGlynn, from California State University in Dominguez Hills resulted in the Darwin invertebrate biodiversity lab hosting four of Terry's students for six months in 2014. The students, from left, Abe Perez, Erica Parra, Joey Fasheh and Sara Hu worked on a range of ant projects supervised by Dr Hoffmann.



From left Stef Oberprieler, Clemence Maillot, Alice Delude, Joey Fasheh, Erica Parra, Justine Boussier, Julio Mario Chaul, Abe Perez and Sara Hu.



CSIRO technician, Sam Walker and French intern, Leo Simon, from SupaAgro University in Montpellier, France, analysing soil and resin samples for inorganic (nitrate and ammonium) and organic (amino acid) nitrogen. The aim of Leo's project was to determine wet season soil nitrogen mineralisation rates under three fire treatments on the Tiwi Islands.



Clemence Maillot at her microscope sorting through the invertebrates collected during the 2014 Kakadu National Park biodiversity survey. PhD student, Stefanie Oberprieler, showing Clemence key characters to look for in some of the major insect orders commonly found in the traps.





## STUDENT PROFILE

by Sara Hu



During my time at CSIRO, I conducted research on the foraging behaviour of *Melophorus anderseni* in relation to their parasitism of meat ant *Iridomyrmex reburrus* colonies. *Melophorus anderseni* parasitizes the meat ants by foraging inside their nests and stealing their brood. Under guidance from Dr Ben Hoffmann, I designed my experiment to look at the activity of both *M. anderseni* and *I. reburrus* colonies and to explore potential mechanisms of how *M. anderseni* parasitize the meat ants. I had a challenging and rewarding experience not only collecting data in the field, but also running analyses on my data and writing.

I measured activity levels of both species along with the soil temperature at their nests or foraging trails. *Melophorus anderseni* activity is positively related to soil temperature, compared to *I. reburrus* activity, which is negatively related to soil temperature, such that activity rates of the two species are negatively related. I also looked at foraging behavior of *M. anderseni* and found that when they

steal items from the meat ants, they steal brood more than 95 per cent of the time. I also compared the speed of *M. anderseni* workers to *I. reburrus* workers, and *M. anderseni* is significantly faster than *I. reburrus* for all activity types measured.

Also while with CSIRO, I had the opportunity to do help with fieldwork in Kakadu National Park. The study I took part in is the longest running of its kind and I felt incredibly fortunate to be given the opportunity to participate in something so grand in scale. I spent 12 days in remote areas of Kakadu conducting invertebrate surveys by using pitfall traps and performing hand collections. I also assisted the researcher in charge of vertebrate and flora surveys for my team, Helen Brock.

Lastly, while at CSIRO I learned a lot about Australian flora and fauna and in particular, about ants. It was such a great privilege to work with leading ant experts. My experience at CSIRO is invaluable for me as I continue my studies.



The mechanisms by which *Melophorus anderseni* parasitize *Iridomyrmex reburrus* (pictured) colonies was explored by student trainee, Sara Hu.  
PHOTO: ©ALEX WILD





## STUDENT PROFILE

### by Abe Perez

During my time with CSIRO Ecosystem Sciences in Darwin, I worked with Dr Ben Hoffmann on a study looking at ant communities across the Top End of the Northern Territory. Northern Australia's tropical savannas are largely intact and cover about two million square kilometres. Throughout this vast expanse of savanna exists a mosaic of different habitat types, such as floodplains. The project investigated whether north Australian floodplain ant communities are a distinct fauna, or a subset of the savanna fauna. My role was to identify the thousands of ants sampled and analyse them.



The Giant snappy ant, *Odontomachus turneri*, was one of the species collected by Abe Perez as part of his floodplain ant fauna study.  
PHOTO: © CRAIG NIEMINSKI



I found that although much of the floodplain fauna was comprised of general savanna species, there were many species that were floodplain specialists. Indeed, because floodplains are not a habitat normally surveyed for ants we found numerous new species. The management implications are that floodplains are the sole habitat for many species, and therefore consideration should be given to minimising disturbance over some floodplain areas to maintain regional biodiversity.

I also was involved in a project that, even now, I cannot quite believe I was part of! I spent a week with Northern Territory Government biologists in beautiful Kakadu National Park sampling invertebrates and being transported in a helicopter to various remote (and I mean remote!) sampling sites, as part of a long-term fire and biodiversity monitoring project. Even though temperatures surpassed 45 (I believe it was 47 one day) and my diet was instant noodles and trail mix, it was one of the greatest experiences of my life.

Another field trip I was involved in was ant sampling in the Maranoa region of Queensland. For this study, the focus was to determine the sensitivity of the region's flora and fauna to changed fire regimes and how to best manage the impacts of altered fire regimes potentially associated with coal seam gas development. My role was to sample the ant communities at sites with various fire histories. I was able to see ants that were not present in the Northern Territory as well as other wildlife such as an echidna!

The CSIRO Darwin laboratory is a wonderful place and I am truly grateful for the opportunity to conduct research, take part in amazing field work and to have met all the wonderful people that work there. Thank you CSIRO Darwin for a wonderful experience!





## STUDENT PROFILE

### by Erica Parra

As a student intern at CSIRO I was given the opportunity to develop my own research project under the supervision of Dr Ben Hoffmann and Professor Alan Andersen. My project was located in the monsoon rainforest patch at Fogg Dam, about 70 km east of Darwin.

My work was to investigate what happens to ground-dwelling rainforest ant faunas during the wet season when the ground floods – do they just sit underground in waterlogged soil, or do they move to higher ground at the bases of trees? Sampling was done continuously from March to July. Samples were brought back to the lab where they were pinned and identified to contribute to the TERC ant collection.

We anticipated that there would be broad patterns of island biogeography (i.e. more species on islands with greater area) at the bases of trees that essentially formed island refuges during the wet season. Interestingly we did not find this pattern. Patterns of recolonisation as the area dried out after the wet season

indicate that ants use both strategies to survive flooding.

In addition to working on my own research project I was given the opportunity to assist with others. During my 7-month stay at CSIRO Darwin I was fortunate enough to work at Kakadu National Park and on the Tiwi islands. The fieldwork at Kakadu consisted of setting up pitfall traps, hand collections and collection from a vertebrate trap. Since the focus of this project is to find the diversity of insects our collecting was not limited to just ants. I went to the Tiwi islands on two separate occasions. On the first time I worked with Michelle Freeman who is looking at fire and vegetation dynamics. On my second visit I went out with Samantha Walker and Jon Schatz to collect data on to how much fuel is present in the carbon plots. I was able to see and learn what measurements and simple calculations can be used to predict how intense a fire will burn in a given site.

Working at CSIRO was a surreal experience, I am extremely lucky to have had this opportunity and work side by side with some of the most knowledgeable people in the field of invertebrate ecology. I learned so much at CSIRO and I can't wait to take all this knowledge back and put it to use back home.



A species of *Strumigenys* was found at Fogg Dam as part of Erica Parra's research project.





## Volunteer fellows

STUDENT	DATE	WORK AREA	CSIRO SUPERVISOR
Coralie Tate	January	Soil carbon dynamics	Dr Richards
Noemie Saint Germes	September – October	Ant biodiversity	Dr Hoffmann
Maelle Besnard	October – December	Ant biodiversity	Prof Andersen
Laurence Berville	November – December	Ant biodiversity	Dr Hoffmann

**Noemie Saint Germes from France worked in the invertebrate biodiversity lab as a Volunteer Fellow for two months. She is pictured here with from left Alan Andersen (left) Jodie Hayward (right) and Clemence Maillot (at the microscope).**





# Indigenous engagement in education

## Jack Cusack Science Program for Indigenous students

Contact: Ms Barbara McKaige

### A PARTNERSHIP BETWEEN CSIRO AND KORMILDA COLLEGE IN DARWIN

“Heaps of fun” was how a group of Indigenous students from Darwin’s Kormilda College summed up their experience of working on CSIRO’s savanna burning experiment in June at the Territory Wildlife Park near Darwin, as part of the Jack Cusack Science Program.

Working side-by-side with scientists, Year 11 students, Dwayne Alangale, Lyndon Gumbula, Patrick Ishiguchi, Sioana Maymura, Trevenna Yarmirr and Kayanne Shower collected data on fuel loads, lit experimental fires on research plots at the park, took measurements of fire behaviour and collected post-fire data.

For all of the students, learning how to use a drip torch to light fires under the supervision of Bushfires NT staff was a highlight. Only one of the students, Dwayne Alangale, had previous experience of burning with his grandfather, a traditional owner in the Daly River region.

Kayanne Shower really appreciated the opportunity to learn more about fire ecology. “Fires are such a big thing up here in the NT and having this knowledge will really help me in the future,” she said. Patrick Ishiguchi particularly enjoyed working with researchers to measure patchiness, char heights and scorch heights after the experimental plots had been burnt.

This year the students adopted a novel approach to reporting on their experiences with CSIRO. Instead of writing a report or developing a PowerPoint presentation about the fire experiment, the students wrote a song called “Gonna find our spark”. With the assistance of CSIRO researchers and the NT Music School’s VAMPtv (an online arts forum for remote NT schools) the students wrote lyrics, selected music and recorded the song. In writing the lyrics, the students drew on the information they learnt from scientists during the experimental burning, demonstrating their understanding of fire ecology concepts.

For the production of the song, fellow Indigenous student, Liam Stansfield, joined the group and with his powerful vocals, gave the chorus an extra edge. The music clip was aired across NT schools in March as part of VAMPtv’s fortnightly online program, and can be viewed on CSIRO’s YouTube Channel <https://www.youtube.com/watch?v=uM-fJWFar7Q>.

Patrick Ishiguchi summed up the 2014 Jack Cusack Science Program experience with the following: “learning about science, learning about the environment, working hard, meeting new people and making a cool music clip. It was great!,” he said.

In partnership with Kormilda College, CSIRO initiated the Jack Cusack Science Program for Indigenous students in 2007. The program, which is named after Indigenous botanist Jack Cusack who was with CSIRO for 35 years, is coordinated by Barbara McKaige. It provides students with practical experience in science and encourages them to consider science as a career option.





The Kormilda Students awaiting instruction before lighting fires on the experimental plots.



Dwayne Alangale lighting an experimental fire under the careful supervision of Bushfires NT staff, as part of CSIRO's savanna burning research.



Kayanne Shower (left), Trevenna Yarmirr and Sioana Maymura collecting fine fuel data with Dr Dick Williams.



Dwayne Alangale (left) digging up timers after the experimental fires to measure rate of fire spread, with visiting scientist Dr John Morgan from La Trobe University in Victoria.





## Tiwi College

**Contact: Ms Barbara McKaige**

In 2014 Tiwi College students continued monitoring key Tiwi plant and bush tucker species with CSIRO researchers and the Tiwi Land Rangers. The ecological monitoring program aimed to:

- Raise awareness amongst Tiwi students about plants of cultural significance to Tiwi people;
- Teach students about scientific monitoring and the use of field equipment to empirically record ecological data (e.g. GPS, diameter tape, Clinometer and completing datasheets); and
- Record plant flowering and fruiting responses to seasonal/ ecological change as a means of determining potential future climate change impacts.

Plant species to monitor were chosen with Tiwi project partners and were selected based on their importance as historically useful or significant to Tiwi people, as well as being readily accessible, identifiable and locally abundant. Baseline data was recorded during selection and tagging, with information collected on the name, location (latitude/longitude), health (stem and canopy), stem diameter at breast height (DBH in cm) and whether flower or fruit were observed.



Dr Anna Richards (right) showing Kimberly Cunningham and Jess Stassi how to use a GPS to locate previously tagged trees.



John Pupangameri (left) and Kyle Darcy measuring the diameter of Jukwartirringa (*Eucalyptus tetradonta*).





Dr Garry Cook and Tiwi College student Alex Kantilla looking through a clinometer.



Curtis Tipiolura and Alex Kantilla measuring the height of Minta (*Cycas armstrongii*) with Dr Garry Cook.



One of the plants monitored by the students was Yankumwani or Green Plum (*Buchanania obovata*). The Yankumwani fruit are eaten when they are green but soft to touch. The inner red bark of the tree is used as a red dye for fibre crafts, and the stems of young plants are used as an aid when climbing tall trees.



Kyle Darcy with Curtis Tipiloura looking through a clinometer with Tiwi College Assistant Teacher, Mark Tunmuck-Smith.



Kimberly Cunningham measuring the diameter of Jukwartirringa (*Eucalyptus tetrodonta*).



Alex Kantilla using a clinometer to measure tree height.



Dr Anna Richards advising Alex Guy how to use a clinometer.



# Research visitors

VISITOR	DATE	AFFILIATION	CSIRO CONTACT
Ms Kate Hadden	January – December	Tiwi Land Council	Prof Andersen
Dr Bruce Hawke	February	CSIRO Land and Water, Adelaide, SA	Dr Richards
Associate Professor Andrew Suarez	February – June	University of Illinois, USA	Dr Hoffmann
Dr Rik Buckworth	April	CSIRO Marine and Atmospheric Research, Brisbane QLD	Prof Andersen
Ms Sophie Palfi	April	Charles Sturt University NSW	Prof Andersen
Mr Shaun Ansell	May – December	Warddeken Land Management, NT	Prof Andersen
Dr John Morgan	June	La Trobe University, Melbourne, VIC	Dr Williams
Mr Greg McCarthy	June	Victorian Department of Sustainability and Environment VIC	Prof Andersen
Dr Florian Menzel	July	University of Mainz, Germany	Prof Andersen
Mr Michal Houadria	July	University of Mainz, Germany	Prof Andersen
Dr Kate Parr	July	University of Liverpool, UK	Prof Andersen
Mr Tom Bishop	July	University of Liverpool, UK	Prof Andersen
Dr Richard Corlett	July	Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, China	Prof Andersen
Dr William Cornwell	July	George Washington University, USA and University of NSW	Prof Andersen and Dr Richards
Dr Cuan Petheram	July	CSIRO Land and Water Flagship, QLD	Prof Andersen
Dr Alexander Vicente Christianini	July	Universidade Federal de Sao Carlos, Brazil	Prof Andersen
Dr Parveen Sangwan	July	CSIRO Manufacturing Flagship, Clayton VIC	Dr Richards
Mr Cameron Way	July	CSIRO Manufacturing Flagship, Clayton VIC	Dr Richards
Dr Rolf Oberprieler	July	National Research Collections Australian, Canberra ACT	Prof Andersen
Dr Amy Zanne	July	George Washington University, USA and University of NSW	Prof Andersen and Dr Richards
Dr Israel Del Toro	July – August	University of Copenhagen, Denmark	Prof Andersen
Dr Don Feener	July – August	University of Utah, USA	Prof Andersen
Prof José Manuel Vieira Fragoso	July – August	Stanford University, California, USA	Prof Andersen
Mr Jonas Marahalvas	July – August	University of Uberlandia, Brazil	Prof Andersen
Prof Marcelo Tabarelli	July – August	Federal University in Pernambuco, Brazil	Prof Andersen
Prof Inara Roberta Leal	July – September	Federal University in Pernambuco, Brazil	Prof Andersen
Dr Marcus Barber	August	CSIRO Land and Water Flagship, Brisbane QLD	Prof Andersen
Dr Mick Meyer	August	CSIRO Oceans and Atmosphere Flagship, VIC	Dr Cook
Dr Brett Murphy	August	University of Melbourne VIC	Dr Cook
Ms Jane Bennett	August	CSIRO Board Member, TAS	Prof Andersen
Dr Mick Meyer	October	CSIRO Oceans and Atmosphere Flagship, VIC	Dr Cook
Mr James Cifuentes	November	Griffith University	Prof Andersen
Dr Shaun Levick	November	Max Planck Institute for Biogeochemistry, Jena, Germany	Drs Cook and Richards, and Prof Andersen
Ms Laurence Berville	November – December	Fyssen Foundation, France	Dr Hoffmann



## Ant collaborators



University of Mainz PhD student Mickal Houadria (pictured) visited the ant biodiversity lab with his supervisor Dr Florian Menzel as part of their work on ant functional diversity in rainforests. Mickal first visited TERC as a student trainee in 2008, and then returned to undertake his Masters on rainforest ants of the Tiwi Islands.

## Ants and climate change

Dr Israel Del Toro, a former CSIRO-sponsored Fulbright fellow, returned to the Darwin laboratory for two months in 2014. During his visit, Israel summarised the data from a previous collaborative project which documented ant biodiversity along the north-south rainfall gradient in the Top End. He used statistical models to predict how ant communities might change under future climate change scenarios Israel also databased and georeferenced 3500 ant specimens from the Darwin Tropical Ecosystems Research Centre invertebrate collection for subsequent use in distribution modelling analyses. Finally, Israel worked with Professor Alan Andersen on a manuscript highlighting the key findings of their collaborative research, which shows how ant community assemblages respond to changing precipitation patterns.



Dr Israel Del Toro

## International ecologists descend on Darwin!

Cairns was the host city of two major international conferences (the International Union for the Study of Social Insects Congress and the annual conference of the Association for Tropical Biology and Conservation) over successive weeks in July, and several delegates took the opportunity to visit Prof Andersen in Darwin. They included ant ecologists Dr Kate Parr and her PhD student Tom Bishop from University of Liverpool, Dr Alexander Christianini (a specialist in ant-plant interactions) from Universidade Federal de Sao Carlos, Brazil, Prof Don Feener (an ant community ecologist specialising in ant parasitism by phorid flies) from University of Utah, Prof Inara Leal (a specialist in ant-plant interactions) from Universidade Federal de Pernambuco, Brazil, and Mr Jonas Marahalvas (a PhD student working on responses of savanna ants to fire) from University of Uberlandia, Brazil. Also visiting were the Chairman of the ATBC's Conservation Committee, Dr Pia Parolin, wildlife biologist and socio-ecologist Prof Jose Fragoso from Stanford University, and senior Brazilian disturbance ecologist Prof Marcelo Tabarelli.



International ant collaborators in Kakadu National Park in July.

From left: Professors Marcelo Tabarelli, Inara Leal and Jose Fragosa.



University of Liverpool's Dr Kate Parr with PhD student Tom Bishop.





# Scientific services

## Consultancies

CSIRO OFFICER	PROJECT TITLE	CLIENT
Prof Andersen	Ants as indicators of minesite rehabilitation on Groote Eylandt	Cumberland Ecology
Dr Hoffmann	Yellow Crazy Ant Management	YBE (2) Pty Ltd
	Yellow Crazy Ant Management	Dhimurru Aboriginal Corporation

## Refereeing

CSIRO OFFICER	PUBLICATIONS REFEREED (in alphabetical order)
Prof Andersen	<i>Annals of Forest Science</i> <i>Biological Conservation</i> <i>Conservation Biology</i> <i>Ecological Applications</i> <i>Entomological Science</i> <i>Functional Ecology</i> <i>Insect Conservation and Diversity</i> <i>Insectes Sociaux</i> <i>Journal of Applied Ecology</i> <i>Journal of Arid Environments</i> <i>Journal of Biogeography</i> (x2) <i>Journal of Tropical Ecology</i> <i>Journal of Insect Conservation</i> <i>Oecologia</i> <i>Proceedings of the Royal Society B</i> <i>Restoration Ecology</i> <i>Sociobiology</i> (x3)
Dr Cook	<i>Anais da Academia Brasileira de Ciencias</i> <i>Austral Ecology</i> (x3) <i>Environ Res Lett</i> <i>Journal of Tropical Ecology</i> <i>Soil Research</i>



# Refereeing (continued)

CSIRO OFFICER	PUBLICATIONS REFEREED (in alphabetical order)
Dr Hoffmann	<i>Agricultural and Forest entomology</i> (x2) <i>Austral Entomology</i> <i>Biodiversity and Conservation</i> (x4) <i>Bioinvasions Records</i> <i>Biological Invasions</i> <i>Biotropica</i> <i>Bulletin of Entomological Research</i> (x4) <i>Ecological Applications</i> <i>Ecosphere</i> Eradication plan – Tropical Fire Ant <i>Solenopsis geminata</i> at Ashmore Reef CMR Commonwealth Marine Reserve <i>Insect Conservation and Diversity</i> <i>IUCN WCPA's PARKS Journal</i> <i>Journal of Applied Ecology</i> (x2) <i>NeoBiota</i> <i>PLoS ONE</i> <i>Proceedings of the Hawaiian Entomological Society</i>
Dr Richards	<i>Environmental Research Letters</i> <i>Austral Ecology</i>
Dr Williams	<i>Australian Journal of Botany</i> (handled > 100 submissions as Editor-in-Chief) <i>Science of the Total Environment</i>

# External positions

CSIRO OFFICER	POSITION
Prof Andersen	Professorial Fellow – Charles Darwin University Associate Editor – <i>Diversity &amp; Distributions</i> Associate Editor – <i>Austral Ecology</i> Editorial Board member, <i>Hot Topics in Ecology</i> Editorial Board member – <i>Journal of Insect Conservation</i> Editorial Board member – <i>Insectes Sociaux</i> Chair – Christmas Island Crazy Ant Management Steering Committee Selection Committee, NT Fulbright Programme Chair, Local Organising Committee, 2014 Ecological Society of Australia conference Scientific Committee, 2014 Association for Tropical Biology and Conservation conference Conservation Committee, Association for Tropical Biology and Conservation
Dr Cook	Professorial Fellow – Charles Darwin University Member – Bushfires Council NT
Dr Hoffmann	Editorial Board Member – <i>Biodiversity &amp; Conservation</i> Editorial Board Member – <i>Ecological Management and Restoration</i> Editorial Board Member – <i>Bulletin of Entomological Research</i> Member – IUCN SSC Invasive Species Specialist Group Member – Christmas Island Crazy Ant Scientific Advisory Panel Board Member – NT Horticultural Association Honorary Research Associate – Victoria University of Wellington, New Zealand
Dr Richards	Associate Editor – <i>Austral Ecology</i> Adjunct Research Fellow – Charles Darwin University
Dr Williams	Editor-in-Chief – <i>Australian Journal of Botany</i> Professorial Fellow – Charles Darwin University Chair – Environment and Scientific Advisory Group, Parks Victoria
Ms Woodward	Member – City of Stirling Natural Environs Working Group





# Research communication

## Media

### SUMMARY OF KNOWN MEDIA COVERAGE OF CSIRO'S DARWIN-BASED RESEARCH IN 2014

DATE	CSIRO OFFICER	TOPIC	MEDIA OUTLET
January 6	Dr Williams	Cattle grazing in Victoria's alpine national parks.	ABC 7.30 Report
January 7	Dr Williams	Cattle grazing in Victoria's alpine national parks.	ABC News 24 (Melbourne), ABC News 24 (Regional NSW), ABC News 24 (Brisbane), ABC News 24 (Adelaide), ABC News 24 (Perth), ABC News 24 (Regional Queensland), ABC News 24 (Hobart), ABC News 24 (Canberra), ABC News 24 (Regional Victoria), ABC News 24 (Albany)
January 18	Dr Williams	Cattle grazing and fire in the Victorian alps	ABC News 24 (Melbourne), ABC News 24 (Regional NSW), ABC News 24 (Brisbane), ABC News 24 (Adelaide), ABC News 24 (Perth), ABC News 24 (Regional Queensland), ABC News 24 (Hobart), ABC News 24 (Canberra), ABC News 24 (Regional Victoria), ABC News 24 (Albany)
January	Dr Hoffmann	Tropical fire ants on the Tiwi Islands	<i>Professional Pest Manager</i>
February 19	Ms Burle	Effects of grazing on ants in Australia's tropical savannas	ABC Country Hour, ABC Tropical North online
February 24	Dr Hoffmann	Pest ants in houses	ABC774 Melbourne
February 24	Dr Hoffmann	Yellow Crazy ants in Kuranda, north QLD	<i>Cairns Post</i>
February 26	Dr Williams	Alpine grazing	<i>Weekly Times</i>
March 1	Dr Hoffmann	Singapore ant infestation in Laverton, WA	<i>Perth Now News</i>
March 2	Dr Hoffmann	Singapore ant infestation in Laverton, WA	<i>Sunday Times, Perth</i>
March 6	Dr Williams	Reintroduction of grazing in the Victorian alps	<i>Weekly Times</i>
March 12	Dr Williams	Reintroduction of grazing in the Victorian alps	<i>Weekly Times</i>
March 13	Dr Williams	Reintroduction of grazing in the Victorian alps	<i>Weekly Times Now</i>



In May, Professor Andersen hosted the local Darwin media at the prescribed burn of savanna woodland at CSIRO. A range of research projects covering both plants and animals are carried out by CSIRO, Charles Darwin University and the Northern Territory Government at the Berrimah site. According to Prof Andersen, for the CSIRO block to be representative of savannas in the broader Top End environment, it needs to be burnt at least every five years. “In the long-term absence of fire, savanna is converted to forest and loses much of its biodiversity”, he said.



DATE	CSIRO OFFICER	TOPIC	MEDIA OUTLET
March	Mr Del Toro	Using ants to predict the impact of climate change on biodiversity	<i>Experiment</i> website
April issue	CSIRO	Gulumoerrgin (Larrakia) seasonal calendar	<i>Top Notes</i> Land for Wildlife Newsletter
May 9	Dr Andersen	Savanna burning to maintain biodiversity on the CSIRO site in Berrimah	ABC Country Hour Alice Springs; ABC Country Hour Darwin
May 10	Dr Andersen	Savanna burning to maintain biodiversity on the CSIRO site in Darwin.	ABC News Darwin; ABC News Albany.
May 11	Dr Andersen	Savanna burning to maintain biodiversity on the CSIRO site in Berrimah	<i>Sunday Territorian</i>
June 19	Dr Hoffmann	Yolngu Business Enterprises - Yellow crazy ant management in north-east Arnhem Land	<i>Farm Weekly</i>
June 23	Dr Hoffmann	Yolngu Business Enterprises - Yellow crazy ant management in north-east Arnhem Land	<i>Ecos Magazine</i>
July 30	Dr Hoffmann	Yellow Crazy ants	<i>Daily Examiner</i> NSW
July 30	Ms Arcoverde	Effects of grazing on ants in Australia's tropical savannas	ABC Country Hour, ABC Tropical North online
September 29	Dr Cook	Savanna burning and greenhouse gas emissions	ABC Country Hour NT ABC News Northern Territory ABC Online ABC Outback Rural Report <i>ECOS</i> online magazine
November 8	Dr Cook	Savanna burning and greenhouse gas emissions	<i>ABC Environment</i> online
December issue	CSIRO	Tiwi College work experience student at CSIRO	<i>The Tiwi – News for Traditional Owners</i>





# Public awareness

## CONFERENCES AND WORKSHOPS

DATE	CSIRO OFFICER	CONFERENCE/WORKSHOP
March	Prof Andersen	11th Savanna Science Network meeting, Kruger National Park, South Africa.
March	Dr Richards	Sustainable Agriculture Flagship Soil Carbon and Nitrous Oxide Workshop, Adelaide, SA
April	Ms Oberprieler	Centre for Biodiversity Analysis Conference, Canberra, ACT
April	Prof Andersen	Writing workshop for the Ecosystem Science Long-Term Plan
April – May	Dr Cook	European Geophysical Union Conference, Vienna, Austria
May	Ms Ligtermoet	National Environmental History PhD Workshop at Australian National University, ACT
June	Ms Oberprieler	Atlas of Living Australia Symposium, Canberra, ACT
June	Dr Richards	Sustainable Agriculture Flagship Vegetation Sinks Workshop, Alice Springs, NT
June – July	Ms Ligtermoet	Australian Society Fish Biology & Australian Society for Limnology Joint Congress, Darwin, NT
July	Prof Andersen, Dr Hoffmann	International Union for the Study of Social Insects, Cairns, QLD
July	Prof Andersen, Dr Hoffmann & Ms Burle Arcoverde	51st Annual Meeting of the Association for Tropical Biology and Conservation, Cairns, QLD
August	Dr Richards	Department of Environment CFI Savanna Burning Sequestration Methodologies Workshop, Darwin, NT
September – October	Prof Andersen, Dr Cook, Dr Liedloff, Dr Richards, Ms Burle Arcoverde, Ms Bonney & Ms Oberprieler	Ecological Society of Australia Conference, Alice Springs, NT
November	Dr Hoffmann	Entomological Society of America, Portland, Oregon, USA
November	Ms Ligtermoet	IUCN World Parks Congress, Sydney, NSW
November	Ms Ligtermoet	Natural Resources and Indigenous Livelihoods Short Course, Charles Darwin University, Darwin, NT
November	Ms Oberprieler	ANU Higher Degree Research Conference, Canberra, ACT
December	Ms Woodward	2014 Australian Frontiers of Science: The Edges of Astronomy, Canberra, ACT

## Ecosystem Science long-term plan

In February, CSIRO in Darwin hosted a workshop contributing to the development of the Australian Ecosystem Science long-term plan. The Plan establishes clear directions for sustaining and enhancing the long-term future of Australian ecosystem science, identifying critical priorities for infrastructure, research, human capability development, and uptake into policy and management. Development of the Plan was led by the Terrestrial Ecosystem Research Network, the Australian Academy of Science and the Ecological Society of Australia, with wide engagement from across the ecosystem science community in Australia. The Darwin workshop was one of a series held across the country in 2014.



In April, the working group reviewed input, identified the key priorities and began writing the Ecosystem Science long-term plan. Back row (from left): Mike Bull, Adrienne Nicotra, Alan Andersen, Mark Westoby, Bronwyn Harch. Front Row (from left): Stuart Phinn, Margaret Byrne, Glenda Wardle and Tim Moltmann.



While in South Africa Professor Andersen also gave a talk to students on ant biodiversity at the Moyo Conservation Project in South Africa's Limpopo Province, near the borders of both Botswana and Zimbabwe.

## Savanna science network meeting in Kruger National Park

In March, Professor Alan Andersen attended the 11th Savanna Science Network meeting in Kruger National Park in South Africa. The network meeting is an annual international conference for savanna researchers, and plays a key role in connecting scientists from CSIRO with the global savanna community. Many of the international collaborations developed by CSIRO scientists in Darwin have resulted from the meeting, most recently LiDAR work with Dr Shaun Levick from Max Planck Institute for Biogeochemistry in Jena, Germany and ant collaborations with the University of Venda. A feature of the meeting is its interdisciplinary nature, treating savannas as complex socio-ecological systems, and its underlying philosophy of adaptive conservation management.

## Ecological Society of Australia conference in Alice Springs

Nearly all the scientists and students from the CSIRO laboratory in Darwin joined Australia's leading ecologists at the annual Ecological Society of Australia conference in Alice Springs in September. As chair of the conference organising committee, Professor Alan Andersen played a key role in ensuring the conference was a success. More than 500 ecologists, policy makers and land managers participated in the weeklong conference, which showcased the best new ideas in ecology and solutions for environmental management. CSIRO staff presented in a range of symposia on regionally relevant issues such as savanna burning, arid ecology, the ecology of northern development and Indigenous ecological knowledge.



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## Seminars and lectures

DATE	CSIRO OFFICER	SEMINAR/LECTURE
January	Mr Cussonneau	CSIRO Darwin Seminar Series: Grazing Impacts on Ant Communities in Australia's Tropical Savannas
February	Ms Louvrier	CSIRO Darwin Seminar Series: Effect of Grazing on Ant Biodiversity
February	Mr Simon	CSIRO Darwin Seminar Series: The Tiwi Nitrogen Mineralisation Study
March	Mr Fasheh, Ms Hu, Ms Parra & Mr Perez	CSIRO Darwin Seminar Series: Kakadu Fire Plots – 2014 biodiversity monitoring
April	Ms Pettit	CSIRO Science Education's Double Helix Club Holiday Program: Balmy Bugs, Darwin, NT
May	Drs Cook & Richards	Fire Management and Soil Carbon Sequestration in Tropical Savannas, Max Planck Institute, Jena, Germany
May	Dr Cook	Savanna Fires and Greenhouse Gas Emissions, Max Planck Institute, Jena, Germany
May	Dr Hoffmann	Invasive Ants and Their Management in the Galapagos Islands, Galapagos Islands, Ecuador
May	Dr Hoffmann	Invasive Ants and Their Management, Charles Darwin University, Darwin, NT
May	Ms Pettit	Invertebrates, Yr 2/3 Class at Holy Family Primary School, Darwin, NT
June	Ms Burle Arcoverde	Biogeographically Contingent Impacts of Disturbance: Resilience of Savanna Ant Communities in Relation to Grazing in Australia and Brazil, Field Studies in Tropical and Desert Landscape, Mt. Bundy Station, NT
June	Ms Pettit	Insect Adaptations and the Effect of Environmental Changes on Insects, Yr 5/6 Class at Holy Family Primary School, Darwin, NT
July	Prof Andersen	CSIRO Darwin Seminar Series: Overview of Ant Responses to Disturbance
July	Ms Boussier	CSIRO Darwin Seminar Series: Impacts of Grazing on Ant Biodiversity
July	Ms Burle Arcoverde	Grazing Impacts on Savanna Ant Communities in the Australian Seasonal Tropics, ATBC Meeting, Cairns, QLD
July	Ms Burle Arcoverde	CSIRO Darwin Seminar Series: Grazing Impacts on Savanna Ant Communities in the Australian Seasonal Tropics
July	Mr Chaul	CSIRO Darwin Seminar Series: A Revision of the Australian <i>emmae</i> group of species of <i>Strumigenys</i> Smith, 1860
July	Dr Christianini	CSIRO Darwin Seminar Series: Comparative Role of Birds and Ants as Seed Dispersers in the Cerrado, a Neotropical Savanna



DATE	CSIRO OFFICER	SEMINAR/LECTURE
July	Dr Del Toro	CSIRO Darwin Seminar Series: Climate Change and Functional Diversity in Ants
July	Ms Delude	CSIRO Darwin Seminar Series: Kakadu Invertebrate Survey, Wet Season 2014
July	Mr Fasheh	CSIRO Darwin Seminar Series: Ants as Bioindicator: Native Ant Recovery from <i>Anoplolepis gracilipes</i> Infestation and Strip Mining in NE Arnhem Land
July	Dr Fragoso	CSIRO Darwin Seminar Series: Indigenous Livelihoods and Biodiversity in Amazonian Protected Areas: Responses to Clearing Outside of Forests
July	Dr Hoffmann	Invasive Ants and Climate Change, ATBC Meeting, Cairns, QLD
July	Ms Hu	CSIRO Darwin Seminar Series: Parasitism of <i>Melophorus anderseni</i> on <i>Iridomyrmex reburrus</i>
July	Ms Leal	CSIRO Darwin Seminar Series: Anthropogenic Disturbance and Ant-Plant Interactions in Caatinga
July	Mr Maravalhas	CSIRO Darwin Seminar Series: Effects of Fire on Savanna Ants in Brazil
July	Ms Parra	CSIRO Darwin Seminar Series: Where Do They Go? What is the Ant Diversity During a Flood and What is the Pattern of Re-inhabitation After the Wet Season at Fogg Dam's Monsoonal Rainforest?
July	Mr Perez	CSIRO Darwin Seminar Series: Are North Australian Floodplain Ant Communities a Distinct Fauna, or a Subset of the Savanna Fauna?
July	Prof Tabarelli	CSIRO Darwin Seminar Series: Fragmentation and Leaf-Cutting by Ants in Atlantic Forest
August	Dr Richards	The Tiwi Carbon Study, CSIRO, Darwin, NT
September	Ms Burle Arcoverde	Surveying Ants, Charles Darwin University, Darwin, NT
September	Ms Woodward	Collaborative Indigenous Research Partnerships, Natural Resources Institute, University of Manitoba, Canada
October	Ms Woodward	Northern Australia Indigenous Knowledge Systems, Wilp Wilxo'oskwhl Nisga'a, Canada
November	Dr Hoffmann	Advances in Invasive Ant Management and Room for Improvement, Entomological Society of America, Portland, USA
November	Ms Maillot	CSIRO Darwin Seminar Series: Invertebrate Biodiversity in Kakadu National Park
November	Ms Oberprieler	ANU Higher Degree Research Conference – PhD Overview Presentation, Canberra, ACT
December	Ms Pettit	CSIRO Darwin Seminar Series: 15 Years with CSIRO





# Publications

## Journal articles and book chapters

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