



Director's
SUMMARY 2011

Our Values

Through leadership, integrity, service, innovation and team-building, these values and beliefs guide our actions:

- We are committed to providing leadership in research and through such efforts be an exemplar for others
- We are dedicated to best practice in all our endeavours
- We are resolved to produce in a timely manner innovative and relevant outputs
- We are pledged to seek better ways and better science
- We value a collaborative, engaging, caring approach to team-building.

Our Vision

To make the Australian Tropical Herbarium a leader in tropical plant biodiversity research, that conducts diverse, relevant and innovative research; converts that research into useful products; offers training, inspiration and engagement with the community; and, by collaborating with others, achieves a greater understanding of sustainable tropical systems.

ATH staff and students. Back row (L-R) Katharina Schulte, Lalita Simpson, Eda Addicott, Cameron Kilgour, Stuart Worboys, Frank Zich, Caroline Puente-Lelievre, Mark Harrington, Ashley Field, Kaylene Bransgrove. Front row (L-R): Andrea Lim, Gary Wilson, Mark Newton, Darren Crayn, Yumiko Baba. Absent: Sandra Abell-Davis, Peter Bannink, Jonathan Cornelius, Craig Costion, Paul Gadek, Melissa Harrison, Tony Page, Sook-Ngoh Phoon, Gerry Turpin. Cover photo: Gary W. Wilson.



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The Sir Robert Norman Building at JCU, housing the Australian Tropical Herbarium. Image: JCU



From the Director

As Director of the Australian Tropical Herbarium, I find it immensely satisfying to reflect on the activities and achievements of the organisation over the past year. It was a successful year characterised by solid growth in several key result areas and the achievement of all milestones and performance targets.

A particular highlight of 2011 was the establishment of the Tropical Indigenous Ethnobotany Centre (TIEC), a partnership between Traditional Owners, the ATH, CSIRO, the Queensland Government and JCU's Cairns Institute. The TIEC is the first and only Indigenous-led ethnobotany research facility in Australia.

An important governance outcome was the development a Five Year Strategic Plan to carry the ATH through to the end of the current joint venture agreement (March 2015). This Plan declares the aims and aspirations of the organisation and outlines the pathways we will forge to achieve them.

Our research programme continues to diversify while retaining a core focus on plant systematics and biodiversity studies. Income to the ATH from competitive external grants remains strong and research outputs of consistently high quality continue to increase in number year on year. We believe this is due in part to our commitment to building and maintaining effective research partnerships – being good collaborative partners is what drives us.

Our public engagement activities, especially the Plant Identification Workshops, have been well received and in the case of the 'Rainforest Key', award-winning. This innovative online plant identification and information system received a prestigious 'Cassowary Award' in recognition of its value to the community. We are humbled by this honour and inspired toward even greater achievements in the future.

In brief, at the close of the fourth year of operation the ATH is in a strong and growing position, a testament to the dedication and talent of our staff, students and associates. Together, we look forward to continuing in 2012 to build the ATH into leading international tropical plant and fungal biodiversity research institution.

It is my great pleasure to present this fourth annual Director's Summary report. I hope you enjoy reading it.



Prof. Darren Crayn
Director, Australian Tropical Herbarium



Image above and below: Gary Wilson



Introduction

The Australian Tropical Herbarium (ATH) is a joint venture of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Director National Parks (DNP), Queensland Department of Environment and Resource Management (Qld DERM), Queensland Department of Employment, Economic Development and Innovation (DEEDI), and James Cook University (JCU). The ATH's activities are overseen by the ATH Board comprising representatives of the three main participants (CSIRO, JCU, Qld DERM) and an independent chair. The ATH is physically located within the Australian Tropical Forest Institute (ATFI) building on the Cairns campus of JCU, and administratively is part of JCU's Faculty of Science and Engineering (FSE).

The Sir Robert Norman Building (housing ATFI and the ATH) was completed in November 2007 and movement of the MBA and QRS collections was completed by the start of February 2008. The building was opened by the Hon. Anna Bligh, Premier of Queensland on March 4 2008, and the inaugural Director commenced duty on March 31 2008, the Operational Date of ATH.

The ATH boasts state-of-the-art facilities and infrastructure for specimen processing, photography, pest and climate control, and field, herbarium and laboratory research. The main activity is management of the more than 160,000 plant specimens that comprise the CNS collection, a merger of the collections (and staff) of the Australian National Herbarium – Atherton (QRS), the Queensland Herbarium – Mareeba (MBA) and part of the JCU Herbarium collection (JCT) to form an unsurpassed representative collection of north Queensland's flora. Research at the Australian Tropical Herbarium is undertaken on the following themes:

- Theme 1 – Biodiversity, Taxonomy, Evolution
- Theme 2 – Threats and Impacts
- Theme 3 – Plants for People
- Theme 4 – Planning and Management
- Theme 5 – Unlocking our Knowledge

Tropical Indigenous Ethnobotany Centre (TIEC)

The Tropical Indigenous Ethnobotany Centre was established at the ATH in 2011, following a successful workshop in November 2010 which brought together Traditional Owners, scientists and other interested parties to develop the concept. The TIEC is an Indigenous-driven initiative which is built on mutually beneficial partnerships between Traditional Owners (TO), JCU's Cairns Institute, DERM, CSIRO Ecosystem Science and other government agencies and organisations. The Centre researches and collates existing ethnobotanical data, promotes and carries out research in a respectful and culturally appropriate way, and provides awareness, training and education.

2011 Highlights

- **Cassowary Award:** the 'Australian Tropical Rainforest Plants' interactive online identification system won a prestigious Wet Tropics Management Authority Cassowary Award 2011 in the Science section, in recognition of the development teams' "...vision and perseverance in developing an accessible, user friendly and interactive ... key – one of the most significant taxonomic tools in the world." **Experience this impressive product at www.anbg.gov.au/cpbr/cd-keys/rfk/**



The 'Australian Tropical Rainforest Plants' interactive identification key development team receiving the WTMA Cassowary Award.

L-R: Dr Trevor Whiffin, Ms Rebel Elick, Ms Siobhan Duffy, Mr Frank Zich. Absent: Mr Bernie Hyland, Mr Bruce Gray, Dr David Christophel, Dr Judy West, Dr Fanie Venter. Image: Wet Tropics Management Authority

- **Extensive media interest** in the identification of a native species of coffee (*Coffea brassii*), with ATH staff interviewed on capital city breakfast and drivetime radio shows, and nationwide print media coverage.
- Publications: 19 scientific papers, 7 general articles, 1 book chapter, 1 Regional Ecosystem mapsheet were published, and 4 student theses were submitted.
- Presentations: 32 research talks were presented to scientific audiences, and 6 to community audiences.
- Research grants income: nearly \$410,000 in external competitive research grant income was received.
- 5-year Strategic Plan 2011-2015 was completed and endorsed by the Board.
- Postgraduate students: One new student began post-graduate studies at the ATH. In total, ATH staff supervised 14 postgraduate and one Honours research students.
- Visitors: over 250 visitors were welcomed during 2011, including 69 researchers visiting for scientific research purposes.
- Collections: nearly 2000 new specimens were added to the herbarium collections, 1750 edited or redetermined, and over 500 DNA samples were added to the DNA/Tissue Bank.

Rainforest Plant Identification Workshops

ATH in partnership with the Wet Tropics Management Authority delivers a series of workshop-style courses covering the skills needed to identify both native and weedy plant species in the rainforests of the Wet Tropics. The courses are suitable for a broad range of users, including environmental professionals, rangers, students and interested public. The courses are hands-on, with participants visiting local rainforests to put into practice their classroom learning. In 2011 six workshops were delivered across NE Queensland to various Indigenous Ranger groups and the general public.

Governance

Board

The ATH Agreement requires that the ATH is governed by a Board whose role it is to oversee the operations of the ATH and set overall strategic management policy and objectives. The Board comprises two representatives of each of the Participants (CSIRO, DERM, JCU) and an independent Chairperson. The Board meets twice per year, in April and October.

At December 31, 2011, ATH Board members were:

- Dr Greg Leach (Independent Chairperson)
- Dr Jeremy Burdon (CSIRO)
- Prof Paul Gadek (JCU)
- Dr Gordon Guymier (DERM)
- Prof Jeffrey Loughran (JCU)
- Dr Judy West (CSIRO)
- Dr Christine Williams (DERM)

ATH Director

The Director's role is to oversee the day-to-day operations of the ATH including managing staff and volunteers, developing and directing the Research Program as approved by the Board, promoting the ATH, developing and maintaining strategic external partnerships, and working to meet the agreed ATH Key Performance Indicator targets. The Director is also required to maintain significant personal research activity.

The Director reports to the Pro-Vice Chancellor (Science and Engineering) and to the ATH Board.



ATH Board members: (L-R) Dr Greg Leach (Chair), Dr Jeremy Burdon, Dr Christine Williams, Prof Jeffrey Loughran, Dr Judy West, Prof Paul Gadek.

Service

Scientific Enquiries

A total of **130** scientific enquiries (excluding identifications) were answered by ATH staff.

Identifications

A total of **266** plant identifications were performed by ATH staff for external clients.

Visitors

During 2011, **182 people** visited the ATH for non-scientific reasons, many of whom were part of group tours. Of these visitors **8** were international, including groups from the University of Connecticut, Duke University, Tokyo City University, the Papua New Guinea Forest Research Institute, and the Forest Science Institute of Vietnam.

VIPs

- Dr Megan Clarke (CEO CSIRO)
- Mr Niels Marquardt (Consul General, US Consulate General, Sydney)
- Mr Martin Quinn (Ambassador to Federated States of Micronesia)
- Hon. Bob Katter (Federal Member for Kennedy)

Representative Roles (External)

Abell-Davis S, Australasian Mycological Society, Treasurer.
Cornelius J, International Forestry Review Editorial Advisory Board.

Crayn D, Australian Biological Resources Study Advisory Committee, member; *Australian Systematic Botany*, Associate Editor; Council of Heads of Australasian Herbaria (CHAH); Daintree Rainforest Observatory Scientific Committee, member; National Environmental Research Programme, Tropical Ecosystems Hub, Rainforest Implementation Group, member; TreeBoL - Australasian regional coordinator; Wet Tropics Management Authority Scientific Advisory Committee, member.

Gadek P, *Plant Species Biology*, International Organization of Plant Systematists, Board Member.

Harrington M, Australian Systematic Botany Society, North Queensland Chapter Convenor.

Turpin G, Scientific Advisory Committee member, Wet Tropics Management Authority (WTMA); Indigenous Contact Officer for Cape York (Weeds).

Wilson GW, Friends of the Botanic Gardens, Cairns, Patron.

Worboys S, Society for Growing Australian Plants Cairns Branch, Treasurer and Newsletter Editor.

Zich F, Australasian Systematic Botany Society, Treasurer; CNS representative on Managers of Australasian Herbarium Collections (MAHC), subcommittee of CHAH.

Reviewing and Refereeing

ATH staff reviewed a range of manuscripts, grant proposals and theses during 2011.

Journal Manuscripts (total 22): *Australian Journal of Botany* (1 manuscript), *Australian Systematic Botany* (4), *Austrobaileya* (1), *Fungal Biology* (1), *International Journal of Biodiversity and Conservation* (1), *Journal of Systematics and Evolution* (1), *Journal of the Torrey Botanical Society* (1), *Molecular Phylogenetics and Evolution* (4), *Plant*

Systematics and Evolution (2), *The Beagle* (1), *Taxon* (2), *Telopea* (1), *Theoretical and Applied Genetics* (1), *Systematic Botany* (2).

Grant Proposals (total 51): Australian Biological Resources Study (33 proposals), Australian Research Council (1), National Environmental Research Programme (17)

Theses (total 4): PhD (2), Honours (2).

Communications

Media

The ATH received considerable media coverage during 2011 - 30 print or online media articles and 8 radio interviews on local and interstate programmes.

The identification of a native species of coffee on Cape York attracted significant media attention. Numerous articles citing ATH activities and commentary appeared in various newspapers (Courier Mail, Cairns Post, Sunday Mail, Weekend Post - Cairns, Western Cape Bulletin), coffee trade magazines (Bean Scene, Global Coffee Review), and **Darren Crayn** was interviewed on local and interstate radio programmes (ABC 702 Sydney drivetime, Hot FM - Cairns, ABC Coast FM, ABC 774 Melbourne breakfast, ABC North QLD, ABC Far North, and National Public Radio - USA).

Gary Wilson's research on *Nepenthes* (pitcher plants) was featured in the Cairns Post, Solomon Star, and Wildlife Australia magazine, and he was interviewed on ABC Radio Australia.

A range of other stories featuring the ATH, its research or staff appeared in a range of print and online media outlets, such as *'The leafy library of the North'*, *'The zombies in our midst'*, *'Fresh look back on Cook's tour'* and *'Under the microscope'* (Weekend Post - Cairns), *'Australian Tropical Rainforest Plants Edition 6'* (Australian Horticulture), *'Industry bets on wild rice'* and *'Rise of the zombie ants'* (Cairns Post), *'Mystery tree discovery'* (Townsville Bulletin), *'The oldest rainforest: 180 million years of evolution makes the Daintree a biological treasure-trove'* (Weekend Australian Magazine and online - www.theaustralian.com.au/news/features/the-oldest-rainforest/story-e6fgr8h6-1226117628781), *'CSIRO Indigenous driven Ethnobotany workshop'* (Rainforest Aboriginal News).

Website

The ATH website (www.ath.org.au) received 171,181 hits and 27,517 visits in 2011. These numbers are 85% and 106% higher than those for 2010, indicating a strong increase in interest in the website.



The ATH Public Reference Collection. Image: Darren Crayn

Facilities

Herbarium

The ATH collection, a fully databased and representative archive of preserved plant specimens that supports the ATH's research and botanical information delivery programmes, is comprised of:

- c. 170,000 specimens that are pressed, dried and mounted on herbarium sheets held in the Collection Room
- c. 16,000 specimens that are preserved in 70% ethanol held in the Spirit Room
- c. 2500 wood blocks

New herbarium specimens accessioned into CNS in 2011 totalled 1894. In addition 812 collection records were edited and 989 specimens were re-identified.

During 2011 the main collection was utilised by 36 visitors for scientific research purposes.

The ATH's integrated pest control strategy proved effective; the collections remained free of pest outbreaks. Maintenance of up-to-date plant nomenclature, specimen processing times and herbarium service delivery (such as specimen loans) exceeded agreed benchmarks.

Public Reference Collection

The Public Reference Collection is an expanding collection of herbarium specimens (currently nearly 3700 specimens representing over 2400 species), literature, interactive CD keys and other resources for identifying plants, available to the public, consultants, and other interested persons to identify their own collections. In 2011, usage totalled 83 hours by 30 external users.

Library

The ATH library collection contains over 500 titles, including all the major serials on the taxonomy of plants relevant to tropical Australia.

Laboratory

The ATH maintains a state of the art molecular genetics lab capable of supporting a wide range of DNA-based biodiversity and evolutionary research methods including sequence analysis and genotyping using a range of techniques from AFLPs to microsatellite analysis.

DNA/Tissue Bank

The ATH is developing a comprehensive cryo-bank of plant and fungal DNA and frozen tissue samples, archived at -80°C. This bank supports molecular genetics studies as well as being an unrivalled resource for bioprospecting in tropical Australian plants and fungi.

Holdings currently consist of c. 5500 samples (500 of which were added during 2011). Our collection represents the majority of vascular plant genera present in the wet rainforests of North Queensland.

Research

Research is undertaken at the Australian Tropical Herbarium on the following five themes:

Theme 1 – Biodiversity, Taxonomy, Evolution

Assessment of tropical plant and fungal biodiversity through systematic and evolutionary studies, including taxonomy, biology, biogeography, ecology, and genetics of tropical plants and fungi.

Theme 2 – Threats and Impacts

Impacts of fragmentation, degradation, weeds and threatening processes on tropical flora, such as exploring genetics and reproductive strategies of environmental weeds leading to improved control strategies, and exploring ecophysiology and quantitative genetics in understanding climate change impacts on the tropical flora.

Theme 3 – Plants for People

Documenting traditional uses of tropical plant and fungal resources, and innovative utilisation such as biodiscovery and bioprospecting, novel crops and commercialisation.

Theme 4 – Planning and Management

Planning and management of tropical flora, and biodiversity and ecosystem management.

Theme 5 – Unlocking our Knowledge

Training and capacity-building including developing more effective ways to deliver herbarium “products” to the community.

Image: Gary Wilson

Theme 1 – Biodiversity, Taxonomy, Evolution

Phylogeography of orchid species complexes of the Australian Wet Tropics

Team: Lalita Simpson (ATH/JCU), Katharina Schulte (ATH), Darren Crayn (ATH), Keith MacDonald (DERM), Mark Clements (CANBR)

Background: This project aims to provide important insights into phylogenetic relationships of closely related orchid taxa of the Australian Wet Tropics and to unravel their biogeographic history in the context of Cenozoic climate change. The project will increase our understanding of patterns of morphological variation within species complexes and will provide insights into the role of past climate changes in the diversification of these groups. It thus will help to improve taxon delimitation and conservation management. Externally funded by the Australian Biological Resources Study, the Australian Orchid Foundation and the Eichler Research Fund (Australian Systematic Botany Society).

2011 Achievements: The team collected orchid populations for three species complexes (*Dendrobium speciosum*, *D. bigibbum*, and the *Cepobaculum* group) in the Wet Tropics and Cape York Peninsula and completed an AFLP pilot study in the Cooktown orchid (*D. bigibbum*). L. Simpson completed her Honours research in the *Dendrobium speciosum* complex and produced the first comprehensive phylogeographic study for a Wet Tropics orchid. The research tested competing species concepts using molecular data (AFLPs), and elucidated the influence of biogeographical barriers along Australia's east coast on the diversification of the group.

Research Outputs: *Thesis:* Simpson (2011a). *Research presentations:* Schulte (2011), Schulte et al. (2011b), Simpson (2011b, c).

Biodiversity and host specificity of tropical rainforest fungal endophytes

Team: Kaylene Bransgrove (PhD candidate JCU, ATH), Sandra Abell-Davis (ATH/JCU), Darren Crayn (ATH), Brett Summerell (RBG Sydney).

Background: This project will examine the diversity and co-evolutionary relationships of fungi that form mutualistic associations with mountain-top restricted plant taxa. Endophytes are fungi that grow asymptotically inside all plant parts. The relationships endophytes form with their hosts are generally accepted to be mutually beneficial, as they contribute to host survival and ultimately to forest health. Endophytes have been found in all plant lineages examined to-date and are also more diverse in the tropics than in temperate regions. The aim of this project is to determine the biodiversity and host specificity of tropical rainforest endophytes in the WTWHA. The uniqueness of the endophyte assemblages from north-east Queensland in comparison with other tropical (Asian and neo-tropics) and temperate regions will be determined. This novel research and results will become a benchmark for tropical endophyte research. To test host specificity of the endophytes in the Wet Tropics, mountain-top representatives of the plant genus *Elaeocarpus*, for which species population data is available, will be used as a focus group. Externally funded by the National Environmental Research Program (NERP).

2011 Achievements: PhD candidate Kaylene Bransgrove has commenced this project, prepared a research proposal and has started writing a literature review for this topic.

Systematics of tassel-ferns (*Huperzia*, Lycopodiaceae)

Team: Ashley Field (ATH/DERM), Peter Bostock (DERM), Joseph Holtum (JCU), Michelle Waycott (Uni. Adelaide and State Herbarium of South Australia), Katharina Schulte (ATH), Leon Perrie (Te Papa Tongarewa – Museum of New Zealand)

Background: The Lycopodiaceae is a globally distributed family of plants in which the species exhibit shoot-forms associated with their habitat. Genus level classifications of this family vary with anywhere from one to thirteen genera recognised. Species of the genus *Huperzia* - tassel-ferns - are among Australia's most threatened plants, are prized in horticulture and are the source of an anti-Alzheimer's drug, but their species diversity is poorly understood. This project will use a total evidence approach including cpDNA, morphological, anatomical and phytochemical characters to construct a phylogeny of Huperzioid Lycopods and to resolve species complexes and more accurately circumscribe taxa. This will underpin the application of conservation legislation and provide genetic tools for the unambiguous provenancing of plants detected in illicit trade.

2011 Achievements: Ashley Field submitted his PhD thesis on systematics and rarity in Australian tassel-ferns (Lycopodiaceae). A paper resolving the classification of the family Lycopodiaceae has been submitted for publication based on a chapter from his thesis and presented a research seminar at the International Botanical Congress in Melbourne.

Research Outputs: Research presentation: Field (2011).

Taxonomy and Phylogeny of Hypogeous Fungi

Team: Sandra Abell-Davis (ATH/JCU), Mark Harrington (ATH), Teresa Lebel (RBG Melbourne), Michael Castellano (Oregon State University), Kentaro Hosaka (National Museum of Nature and Science Japan).

Background: This project will discover, describe and name truffle-like fungi from forests and woodlands of tropical Australia. The diversity of hypogeous (below-ground) fruiting fungi in the tropics at this stage can only be guessed. Using systematic survey techniques we will describe and name at least one new genus and up to 39 new species from an already surveyed site and an unknown number from a new equivalent site. All species will also be DNA-barcoded and phylogenies reconstructed for specific groups. A DNA library has been developed using fungal barcoding primers from the hypogeous species that have been collected (60 species to date).

2011 Achievements: Twelve new species in four genera of truffle-like fungi from the Australian tropics have been chosen to be formally described based on sequence data. This includes six new species of *Chondrogaster* (Hysterangiaceae, Hysterangiales) as well as new records and species of *Austrogautieria*, *Aroramyces*, *Castoreum*, *Hysterangium*, *Gummiglobus* and *Mesophellia*.

Research Outputs: Scientific paper: Bateman et al. (2011).

DNA-Barcoding tropical Australian trees

Team: Darren Crayn (ATH), Craig Costion (ATH, U. Adelaide), Andy Lowe (U. Adelaide, State Herbarium of South Australia), Hugh Cross (U. Adelaide).

Background: DNA Barcoding is a method that uses a short genetic marker to identify unknown samples to a particular species. Our lab is contributing to 'treeBOL', an ambitious long term global project to DNA-barcode the trees of the world. ATH's role is to DNA barcode the Australian tropical rainforest trees. Externally funded by the National Environmental Research Program (NERP).

2011 Achievements: We have DNA-barcoded over 600 species and uploaded the data to iBOL. An important paper was published which provided proof-of-concept of the use of barcode data to determine the species richness of tropical floras independent of taxonomic determination. This establishes a new rapid and cost effective method for rapid biodiversity assessments where accurate nomenclature is less important than accurate species diversity estimation.

Research Outputs: Scientific paper: Costion et al. (2011a). Research presentation: Costion et al. (2011b)

Endophytic fungi

Team: Sandra Abell-Davis (ATH/JCU), Melinda Greenfield (JCU Honours Student), Natalie Dillon, David Astridge, Ian Newton (Qld DPI&F).

Background: Endophytes are fungi that live within leaf and stem tissue without causing disease to their plant hosts and that produce toxic compounds to deter herbivory. Their application as biocontrol agents to reduce the reliance of the agricultural industry on chemicals is yet to be realised. In 2010 Melinda Greenfield determined that the fungus *Beauveria bassiana* could act as an artificial endophyte in the Australian Cavendish variety of banana with the capacity to colonise plants and kill banana weevil borers. Externally funded by the Qld Dept. Primary Industry and Fisheries.

2011 Achievements: *Beauveria bassiana* has been isolated using mealy-worm soil-baiting (180 soil samples baited to date), from incubation of dead house flies and pheromone baited fruit-flies. We have more than doubled our existing library of isolates. We have extracted the DNA and have sequenced two markers (ITS and EF1- α) from 25 individuals of *B. bassiana*. Analysis of the sequence data is almost completed. Colleagues at DEEDI are continuing experiments using foliar application of *B. bassiana* on various other horticulture crops including mango, paw paw and tomato.

Entomopathic fungi

Team: Sandra Abell-Davis (ATH/JCU), David Hughes (Penn State University), Roger Shivas (BRIP Herbarium), Anthony Young (BRIP Herbarium), Nigel Hywel-Jones (BIOTEC Thailand).

Background: This project aims to update the knowledge on fungi in the genus *Ophiocordyceps* (Family Clavicipitaceae), focusing on taxonomy, ecological constraints and distribution across the North Queensland Wet Tropics. *Cordyceps* spp. are common pathogens of insects and other arthropods all around the world, yet the information on the Australian representatives is very poor. The knowledge about the species found in the North Queensland Wet Tropics is especially low. Worldwide, representative species have been proven to be a source of unique chemical compounds with medicinal applications (e.g. cyclosporin), as well as possible biocontrol agents (e.g. *Metarhizium anisopliae*). Within the last 4 years surveys increased the number of recorded morphospecies from less than 30 to over 75 (Hywel-Jones unpubl. obs.), but none of the gathered specimens have yet been identified to species. A recent field trip recovered 6 new species from local ant species in the Queensland Wet Tropics. Although relatively well known from South East Asia, as yet there have been no published records in Australia of this specific ant-pathogenic *Cordyceps*.

2011 Achievements: In July 2011 the ATH hosted the postdoc Anna Schmidt and graduate student Gabriele Ruffato on their first collection trip from Penn State University, USA. Initially the green tree ant *Oecophylla smaragdina* was targeted but larger populations of other infected weaver ants (identification pending) were found at the time of their visit. Field experiments were conducted to observe the behaviour of uninfected ants when they were forced to encounter infected ants. The project aims to determine how the fungus alters the behaviour of ants, potentially through the use of LSD-like chemicals, and whether the spread of spores is aided by micro-climate.

Evolution of halophytes: a phyloinformatic approach

Team: Lindell Bromham (ANU), Camile Moray (ANU), Robert Lanfear (ANU), Tim Flowers (U. Sussex, UK), David Cantrill (RBG Melb.), Dan Murphy (RBG Melb.), Darren Crayn (ATH).

Background: Salinity is a growing problem in Australia and globally. Research into the development of salt-tolerant crops has produced few successes, even though there are over 1500 naturally salt-tolerant flowering plants. If so many salt-tolerant lineages have evolved, why can't we repeat this success in artificial breeding? Our novel, biodiversity-based approach aims to identify traits or preconditions that underlie the evolution of salt-tolerance, creating a unique database of physiological, ecological, taxonomic and DNA sequences for >1000 naturally salt-tolerant species. By providing a better understanding of how salt-tolerance evolves, we aim to inform strategies for developing salt-tolerant plants for agriculture, bioremediation and conservation. Externally funded by the Australian Research Council (ARC).

2011 Achievements: We have analysed the distribution of halophytes across a megaphylogeny of ca. 55,000 angiosperm taxa, revealing an intriguing pattern of many independent origins of salt tolerance but frequent losses. This pattern is repeated in a more detailed study of grasses, mapping 195 salt-tolerant species onto a phylogeny of the grass family that contains ~20% of the described species. We have begun to investigate the distribution of salt tolerance traits in the Order Caryophyllales.

Evolution of photosynthetic pathway in bromeliads

Team: Darren Crayn (ATH), Katharina Schulte (ATH), Andrew Smith (U. Oxford, UK), Klaus Winter (Smithsonian Tropical Research Institute, Panama), Walter Till (Botanical Institute, Vienna, Austria), Thomas Givnish (U. Wisconsin, USA), Georg Zizka (Senckenberg Institute, Germany), Daniele Silvestro (Senckenberg Institute, Germany)

Background: This multidisciplinary project aims to clarify the evolution of key ecophysiological traits, such as Crassulacean acid metabolism (CAM) in the bromeliads. This is being achieved by: (1) using molecular data to build improved phylogenetic trees for the group, and (2) determining the occurrence of CAM in bromeliad species by carbon isotope analysis of plant tissue.

2011 Achievements: The team published a paper which included an investigation of the evolution of C3/CAM photosynthetic pathways

in bromeliads based on a comprehensive 8-locus molecular phylogeny. Two other manuscripts were developed that investigate (1) carbon isotope values across the family Bromeliaceae, and (2) fine scale patterns of carbon isotope discrimination in populations of the genus *Puya*.

Research Outputs: *Scientific paper:* Givnish et al. (2011a). *Research presentations:* Givnish et al. (2011b), Schulte et al. (2011a).

Fire and fungi

Team: Sandra Abell-Davis (ATH/JCU), Mark Harrington (ATH), Andy Baker (DERM), Mark Parsons (DERM), Jonathan Roth (DERM), Andrew Hedges (DERM), Andrew Millerd (DERM).

Background: This project involves habitat attribute analysis of essential food resources (primarily truffle fungi and cockatoo grass, *Alloteropsis semialata*) for the endangered Northern Bettong (*Bettongia tropica*) supporting recovery efforts. Material is harvested from plots (cockatoo grass, truffles and truffle mycelium) to ascertain seasonal and/or fire interval parameters that are considered suited towards maintaining northern bettong habitat. The ATH component of this project was the development of a DNA library using fungal barcoding primers from the truffle species that have been collected (60 species to date). This will allow molecular identification of the mycelium samples and the publication of taxonomic papers describing new truffle species. Externally funded by the Qld Dept. Environment and Resource Management (DERM).

2011 Achievements: All of the cockatoo grass specimens have now been analysed using Near-Infrared-Spectroscopy (NIR) and a set of 200 reference specimens analysed chemically. The relationship between the NIR spectrum and plant chemistry is being explored. This will allow patterns of nutrient quality, for seasonality and fire interval parameters, to be determined to inform management of *B. tropica*. A DNA sequence library has been prepared and molecular analysis of mycelium samples is underway.

Origins of the Wet Tropics flora – a molecular perspective

Team: Mark Harrington (ATH), Craig Costion (ATH, U. Adelaide), Darren Crayn (ATH), James Richardson (RBG Edinburgh).

Background: We are gap-filling published molecular phylogenies with missing Australian taxa, dating these phylogenies, and using them to generate general explanations about tempo and direction of evolution of the tropical rainforest flora: what elements of the extant rainforest flora are derived from Gondwanan stock (relictual taxa) that have differentiated in situ, what are the invasive elements, and where (and when) have they come from?

2011 Achievements: A meta analysis of all published dated phylogenies containing Australian tropical rainforest taxa was undertaken to characterise the temporal dynamics of the post-Miocene floristic interchange with SE Asia. Results indicate that lineages began to migrate between the two areas from about 12 million years ago with the rate increasing through time until the last 5

million years when a substantial decline was observed in the data. Whether this is artifactual (sampling error) or not, is currently being investigated.

Research Outputs: *Scientific papers:* Byrne et al. (2011), Harrington and Gadek (2010). *Research presentations:* Crayn et al. (2011), Harrington (2011)

Phylogenetic diversity analysis in the Wet Tropics flora

Team: Craig Costion (U. Adelaide, ATH), Darren Crayn (ATH), Mark Harrington (ATH), Andy Lowe (U. Adelaide, State Herbarium of South Australia), Hugh Cross (U. Adelaide), Dan Metcalfe (CSIRO), Andrew Ford (CSIRO).

Background: This study is investigating, using a plot-based approach, the relative performance of taxonomic diversity (species counts) and phylogenetic diversity (branch lengths on molecular phylogenies: PD) measures for conservation priority-setting. This project is aligned with the tropical tree DNA-barcoding project and data will contribute to both projects. Externally funded by the National Environmental Research Program (NERP).

2011 Achievements: Sequence data for species representing 585 genera of Wet Tropics plants was generated and analyses showed that taxonomic richness is a good predictor of PD when assessed at the largest spatial scale - across the Wet Tropics flora. However, significant positive correlations were detected between PD and elevation, and PD and the proportion of taxa thought to be of southeast Asian origin. This is consistent with hypotheses that invoke immigration of Asian lineages preferentially into Australian lowland tropical rainforests due to phylogenetic niche conservatism.

Research Outputs: *Thesis:* Costion (2011)

Phylogenetics and evolutionary dynamics of Elaeocarpaceae

Team: Yumiko Baba (ATH, PhD student), Sook-Ngho Phoon (ATH, PhD student), Darren Crayn (ATH), Mark Harrington (ATH), Katharina Schulte (ATH), Maurizio Rossetto (National Herbarium of NSW), Mark Coode (Kew Gardens, UK).

Background: Molecular phylogenetic and biogeographic work is clarifying the origins and patterns of diversification among lineages within the Elaeocarpaceae/Tremandraceae complex. Within the phylogenetic framework, we are analysing population-level genetic and morphological diversity in selected species in order to provide an insight into taxon boundaries, comparative evolutionary responses and speciation mechanisms in dry-adapted shrubs and rainforest tree species. Externally funded by the Australian Biological Resources Study (ABRS) and the Skyrail Rainforest Foundation.

Presentations: Baba (2011a, b), Butcher et al. (2011).

2011 Achievements: A large 3-locus molecular dataset has been compiled representing a broad sample of Australian and Asian *Elaeocarpus* species and preliminary analyses have resolved monophyly of the genus and of some of the Australian groups. Morphometric analysis of the *E. obovatus* complex is largely complete, with 84 specimens scored for 27 qualitative variables. Population genetic analysis of the same specimens scored for morphometrics was initiated and amplification of 9 microsatellite

markers from 170 selected samples was completed. Preliminary scoring indicated that ploidy levels may vary between individuals thus flow cytometry measurements are being undertaken to clarify the cytogenetics.

PhD student Sook Ngho-Phoon began her project on the systematics and biogeography of the *Elaeocarpus polystachyus* complex. Progress to date included compilation of a morphometric dataset scored from existing herbarium specimens, fieldwork in Peninsular Malaysia to collect samples for molecular phylogenetics, and sequencing of these to add to the existing dataset.

Systematics and evolution of Styphelioideae (Ericaceae)

Team: Caroline Puente-Lelievre (ATH, PhD student), Darren Crayn (ATH), Elizabeth Brown (National Herbarium of NSW), Michael Hislop (Western Australian Herbarium), Mark Harrington (ATH), Chris Quinn (ATH volunteer).

Background: This project will resolve the generic limits within the *Astroloma-Styphelia* group, a problem clade of Ericaceae subfamily Styphelioideae, using nuclear and plastid nucleotide sequences. Patterns of relationship will be studied at genus and species level using established molecular techniques. The taxonomic assessment and publication of poorly known and/or undescribed species of high conservation value is a priority. Externally funded by the Australian Biological Resources Study (ABRS) and the Eichler Research Fund (Australian Systematic Botany Society).

2011 Achievements: Compilation of DNA sequence datasets was completed. A multilocus phylogeny of the *Styphelia-Astroloma* clade was reconstructed which justified the description of a new species (*Leucopogon extremus*) and established the phylogenetic framework for a revision of *Astroloma* and the reinstatement of the genera *Stenanthera* and *Stomarrhena*. Biogeographic and molecular dating analyses of the Styphelioideae in Australia and New Zealand were completed and a paper submitted. For population genetic analysis of the *Leucopogon conostephioides* complex we conducted a pilot study on samples from six populations.

Research Outputs: *Scientific paper:* Johnson et al. (2011). *Research presentations:* Puente-Lelievre (2011), Puente-Lelievre et al. (2011), Wagstaff et al. (2011).

Systematics of miscellaneous tropical flora

Staff at ATH are engaged in small taxonomic projects on a range of different Australian tropical plant groups. Some of these small projects are outlined in brief below.

Acacia leptostachya complex

Background: Three *Acacia* species are being investigated to resolve clear taxonomic entities: *Acacia leptostachya*, *A. argentea* and *A. capillosa*. Field observations suggest that *A. argentea* and *A. capillosa* are one species and different from *A. leptostachya*. Also northern populations of *A. leptostachya* appear to be different to southern populations.

2011 Achievements: A field trip resulted in collection of 20 vouchered morphological and DNA collections covering the distributional and ecological range of the complex. Additional herbarium specimens have been loaned from BRI.

Systematics of *Backhousieae*

Background: The systematics of tribe Backhousieae (Myrtaceae) is being investigated with a focus on the status and relationships of *Backhousia* sp. Prince Regent (W. O'Sullivan & D. Dureau WODD 42) and a recently discovered new species restricted to a single peak near Townsville.

2011 Achievements: All known taxa of Backhousieae were sequenced for one nuclear and five plastid markers. The morphological work and illustrations have been completed and a manuscript on the phylogeny of the tribe and containing descriptions of two new species is nearly complete.

Nepenthes in Australasia

Background: Gary Wilson is undertaking PhD studies (part-time) on the systematics and ecology of *Nepenthes* pitcher plants in Australasia. Extensive field and herbarium observations, pollination research, and population genetics are being employed to determine appropriate taxon boundaries in this iconic genus. Externally funded in part by the Wildlife Preservation Society of Queensland.

2011 Achievements: A comprehensive 3 week field trip to Cape York resulted in vouchered morphological and DNA collections of all known species and undescribed entities across their distributional and ecological range. An ecological monitoring study of the Bramston Beach population of *N. mirabilis* was established with a focus on understanding prey and floral visitor abundance and diversity. Taxonomic work on a putative new species of *Nepenthes* from the Gulf Province of PNG (collected by Fanie Venter) is underway. It is expected that a manuscript describing this species will be submitted in early 2012. Compilation of a morphological database (Lucid) of the Austro-Papuan *Nepenthes* has been initiated. This database will be the basis for morphometric work and the production of identification products.

Research Outputs: *General Articles:* Wilson (2011a), Wilson et al. (2011). *Research Presentations:* Wilson (2011b,c,d,e).

Tecomanthe sp. 'Roaring Meg' (L.J.Brass 20236)

Background: The systematics of the genus *Tecomanthe* (Bignoniaceae) are being investigated by Frank Zich and Andrew Ford (CSIRO) with a focus on the status and relationships of *Tecomanthe* sp. 'Roaring Meg' (L.J.Brass 20236).

2011 Achievements: Populations at Mt Misery (Daintree) were visited during the spring flowering season but few plants were found to be in flower. Hand pollination of flowers failed to produce fruit. Additional leaf samples were collected from herbarium specimens at CANB during a visit in June.

The identity of the Mt Windsor *Pellaea* and the Herberton 'Silver' *Pellaea*

Background: Four species of *Pellaea* are recognised as occurring in Australia, but the identity of several populations found in northern Queensland that exhibit intermediate characteristics between the recognised species is uncertain. This study by Ashley Field will use a morphometric and cytological approach to investigate the identity of the Mt Windsor *Pellaea* and the Herberton 'Silver' *Pellaea*.

2011 Achievements: Collecting trips were conducted in the Wet Tropics and Cape York to obtain samples of *Adiantum*, *Pellaea* and *Pteris* for morphometric and phylogenetic investigation.

Re-evaluation of taxonomic concepts in Australian Orchidaceae based on molecular phylogenetic evidence

Team: Katharina Schulte and Darren Crayn (ATH), Mark Clements and Joe Miller (Centre for Australian National Biodiversity Research, Canberra), Peter Weston (Botanic Garden Trust, Sydney), Andrew Lowe and Hugh Cross (University of Adelaide)

Background: This project aims to rigorously re-evaluate highly controversial taxonomic concepts in Australian Orchidaceae based on multi-locus molecular phylogenetic evidence. DNA barcodes and highly informative nuclear markers will be used to reconstruct comprehensive phylogenies, infer character evolution and historical biogeography of Australian Orchidaceae, and to develop molecular identification tools for conservation and legislative enforcement. Externally funded by the Australian Biological Resources Study BushBlitz programme.

2011 Achievements: The team conducted fieldwork with a focus on the Wet Tropics and Cape York Peninsula to sample undercollected orchid species with Dendrobiinae and Bulbophylliinae as priority groups. The ATH orchid living collection increased to 455 accessions. We established an improved high throughput protocol for DNA extractions and added 495 new orchid DNA extracts to the ATH DNA bank. A pilot phylogenetic study was completed with a representative Dendrobiinae data set (200+ samples for three DNA markers).

Research Outputs: *Research presentations:* Schulte (2011), Schulte et al. (2011b).

Theme 2 – Threats and impacts

Cenozoic diversification in Bromeliaceae: character evolution and climate change

Team: Georg Zizka (Research Institute Senckenberg & Goethe University Frankfurt), Katharina Schulte (ATH), Daniele Silvestro, Daniel Cáceres, Ingo Michalak, Sascha Heller (PhD candidates, Research Institute Senckenberg & Goethe University Frankfurt), Rafael Louzada (PhD student, Universidade de Sao Paulo), Elton Leme (Herbarium Bradeanum, Sao Paulo), Ana Maria Benko-Issepon (Univeridade Recife), Kurt Weising (University of Kassel), Pierre Ibisch (University of Applied Sciences Eberswalde)

Background: Bromeliaceae are one of the most important epiphyte families of the Neotropics, and are highly successful in colonising terrestrial as well as epiphytic habitats. Within the family, several lineages underwent rapid radiations in different regions of Central and South America (e.g. Bromelioideae: eastern Brazil, Puyoideae: Andes), whilst others exhibit only a low diversity today (e.g. *Fosterella*: Andes). To unravel the factors that contributed to the evolutionary success of different bromeliad lineages, molecular phylogenies are built based on DNA sequence data and AFLP fingerprints and used to reconstruct the evolution of key traits (e.g. tank habit, leaf succulence, flower morphology). The correlation between trait evolution, the Cenozoic history of the Neotropics (climate, geology, vegetation), and changes in diversification rates will be explored and the historical biogeography of the groups will be reconstructed.

2011 Achievements: Silvestro and Schulte completed analyses of two datasets (Bromelioideae and *Fosterella*) with submission of manuscripts for publication anticipated for 2012. Zizka, Schulte and Givnish organised several symposia on this theme at the XVIII International Botanical Conference (IBC) in Melbourne.

Research Outputs: *Scientific papers:* Cáceres et al. (2011a, b). *Research presentations:* Cáceres et al. (2011c); Heller et al. (2011); Louzada et al. (2011); Michalak et al. (2011a, b); Silvestro et al. (2011a, b); Weising et al. (2011); Wagner et al. (2011).

Theme 3 – Plants for people

Tropical Indigenous Ethnobotany Centre (TIEC)

Team: Gerry Turpin (ATH/DERM), Rosemary Hill (CSIRO), Eda Addicott (ATH/DERM), Sarah Warne and Katrina Keith (JCU's Cairns Institute), Darren Crayn (ATH).

Background: The TIEC is built on mutually beneficial partnerships between Traditional Owners (TO), JCU's Cairns Institute, DERM, CSIRO Ecosystem Sciences and other government agencies and organisations. The centre researches and collates existing ethnobotanical data, promotes and carries out research in a respectful and culturally appropriate way, and provides awareness, training and education. The TIEC aims for recognition as the leader in ethnobotanical research in the Australian tropics, with a focus on north Queensland. Future development may expand activities to include neighbouring countries as appropriate.

2011 Achievements: The Tropical Indigenous Ethnobotany Centre was established at the ATH in 2011, following a successful workshop in November 2010 which brought together Traditional Owners, scientists and interested parties to develop the concept. Activities in 2011 centred on developing TIEC operational policies and procedures, convening the Indigenous Working Group, developing funding proposals and building relationships with Traditional Owners.

Research Outputs: *Scientific paper:* Hill et al. (2011). *Research presentation:* Turpin (2011).

Developing a sustainable wild sandalwood industry in Vanuatu

Team: Tony Page (ATH/JCU)

Background: In Vanuatu, the Agroforestry and Novel Crops Unit (ANCU), in partnership with the national Forestry Department is identifying the conditions required for a successful wild sandalwood industry based on sustainable production in agroforestry systems. Natural populations of sandalwood are currently endangered due to unsustainable whole-tree extraction. Externally funded by the Australian Centre for International Agricultural Research (ACIAR).

2011 Achievements: A second generation whitewood progeny trial was established in Santo, Vanuatu. A whitewood silviculture and domestication workshop was held in Santo. Seed storage facilities and a laboratory were constructed in Port Vila. A whitewood density trial was conducted.

Research Outputs: *Scientific paper:* Tamla et al. (2011).

YUS Conservation Area: agroforestry and livelihoods

Team: Jonathan Cornelius (ATH/JCU), Miriam Murphy (JCU), Tony Page (ATH/JCU)

Background: The Agroforestry and Novel Crops Unit at JCU, in collaboration with the Tree Kangaroo Conservation Project (Woodland Park Zoo, Seattle), is implementing the agroforestry and livelihoods components of the CI/KfW-financed YUS Conservation Area project (tender won by JCU in late 2009). With project partners Pacific Island Projects and Barefoot Community Organizers, we are undertaking intensive surveys in the villages of this remote area, aimed at establishing a solid socioeconomic baseline for future research-for-development agroforestry interventions. These interventions will make a direct contribution to the long-term viability of this internationally important protected area. Externally funded by Conservation International and the German Development Bank.

2011 Achievements: Village socioeconomic surveys and the development of draft monitoring instrument were completed in 2011. We held agroforestry and land use planning workshops in Uruwa, and completed the identification of local priority species for further development.

Development of a PNG timber industry based on community-based planted forests: design and implementation of a national germplasm delivery system

Team: Jonathan Cornelius (ATH/JCU), Tony Page (ATH/JCU)

Background: The production of high quality timber and other forest products from planted trees and forests represents an important development opportunity for Papua New Guinea. This project addresses an important constraint to the development of such an industry, i.e. the unavailability of adequate supplies of timber tree germplasm (seeds or planting stock). We are working in three project hubs in the development of a model approach to germplasm production and delivery, suitable for post-project scaling-up (within-hub) and scaling-out (to new hubs). Teak (*Tectona grandis*) has been selected as the focal species, due principally to its established high commercial value and demand, growing local interest in its cultivation, and its proven suitability to lowland PNG conditions. Wider application of the approach will be facilitated by the preparation of a "flexi-media" toolkit. As well as documenting the approach, the tool-kit, in DVD form, will include print-ready and broadcast-ready training and extension material designed for different target groups. Externally funded by the Australian Centre for International Agricultural Research (ACIAR).

2011 Achievements: The development of novel clonal propagation technique to propagate mature trees was completed in 2011. We also established community woodlot trials in East New Britain and Madang. Much community engagement was undertaken to prioritise local priority species for further development. Independent upscaling of community nurseries was achieved based on workshops carried out in 2010.

Theme 4 – Planning and Management

Regional Ecosystem Mapping

Team: Eda Addicott (ATH/DERM), Peter Bannink (ATH/DERM), John Neldner (DERM), Mark Newton (ATH/DERM), Gerry Turpin (ATH/DERM), Gary Wilson (ATH/DERM).

Background: The Queensland Herbarium (Brisbane) is the lead agency in Queensland for survey and mapping of vegetation communities and regional ecosystems (RE's).

The RE mapping and the associated conservation status of these communities provide information for regional groups, non-government organisations, government departments, local government and business, for planning and management purposes.

The mapping team based at the ATH is responsible for co-ordinating the RE mapping (at 1:100,000 scale) for Cape York Peninsula and Einasleigh Uplands bioregions, and contributes to mapping two other bioregions, Gulf Plains and the Channel Country.

2011 Achievements: A seamless RE mapping coverage for Cape York Peninsula bioregion and a seamless updated RE mapping coverage for Einasleigh Uplands bioregion were completed. All detailed vegetation site data for Einasleigh Uplands Bioregion was completed and entered into the statewide CORVEG database in readiness for the production of RE technical descriptions. A substantial proportion of detailed vegetation survey sites for the Cape York Peninsula and Gulf Plains bioregion were checked and finalised in the CORVEG database. The ATH staff's contribution to the RE mapping for the Channel Country Bioregion was completed.

Research Outputs: *RE mapsheet:* Turpin et al. (2011)

Theme 5 – Unlocking our Knowledge

Australian Tropical Rainforest Plants Key

Team: Frank Zich (ATH/CSIRO), Ashley Field (ATH/DERM), Chris Quinn (ATH volunteer), Peter Bostock (DERM), Jim Croft (CANBR), Judy West (DSEWPaC), Siobhan Duffy (CSIRO)

Background: "Australian Tropical Rainforest Plants Edition 6" (a.k.a. the Rain Forest Key, or RFK) is an interactive multiple-entry identification and information system. A total of 138 characters, covering morphology - habit, bark, leaves, flowers, fruits and seedlings - and some geographic and ecological information ensure reliability and power of the key is high. Illustrated help notes assist with interpretation of characters. Plant images help to confirm identification. Edition 6 includes 2553 species in 175 families, and has attempted to include all flowering plant species present in rainforest of northern Australia in the following life forms: trees, shrubs, vines, forbs, grasses and sedges, epiphytes, palms and pandans. Ferns and lycopods exhibit markedly different features to seed plants and this has required the development of a separate character list for the fern and lycopod module of the RFK. In part externally funded by the Australian Biological Resources Study (ABRS).

2011 Achievements: Over 4720 different users were recorded accessing the online RFK during 2011 and hits on the species pages exceeded 20,000 per month. Ongoing maintenance of the underlying databases has been completed. Approximately 24 online feedback enquiries have been responded to. For the fern module, coding is now complete for all of the rainforest fern species present in the ATH collection. Remaining species will be targeted in upcoming field trips. An image database was compiled containing 1270 images contributed by Bruce Gray, Ashley Field, Garry and Nada Sankowsky and the Australian Plant Image Index. Additional images will be sourced to complete the database.

The RFK was awarded a Cassowary Award by the Wet Tropics Management Authority in recognition of its impact.

Research Outputs: *General articles:* Worboys (2011a,b). *Research Presentations:* Worboys (2011c,d)

Image: Andrea Lim



Publications and Presentations

Publications and presentations by ATH authors for scientific and general audiences are detailed below (ATH authors in bold).

Book Chapter

Poudel R, **Baba Y** (2011) Magnoliaceae. In Watson MF, Akiyama S, Ikeda H, Pendry CA, Rajbhandari KR, Shrestha KK. (eds). Flora of Nepal. Volume 3. Royal Botanic Garden, Edinburgh.

Regional Ecosystem Map Sheets

Turpin G, Bannink P, Richter, D (2011) Vegetation Communities and Regional Ecosystem 1:100,000 Survey and Mapping of the Channel Country Bioregion: Betoota 1:250,000 map sheet.

Scientific Papers

Bateman BL, **Abell-Davis SE**, Johnson CN (2011) Effects of climate on food availability limit the abundance of the endangered Northern Bettong *Bettongia tropica* in marginal populations. *Australian Journal of Zoology* **59**: 177–185.

Byrne M, Steane D, Joseph L, Yeates D, Jordan GJ, **Crayn D**, Aplin K, Cantrill D, Cook LG, Crisp, MD, Keogh JS, Melville J, Moritz C, Porch N, Sniderman JMK, Sunnucks P, Weston PH (2011) Decline of a biome: evolution, contraction, fragmentation, extinction and invasion of the Australian mesic zone biota. *Journal of Biogeography* **38**: 1635–1656.

Cáceres D, **Schulte K**, Zizka G (2011a) Untersuchungen zur Taxonomie, Diversität und Biogeographie der Bromelien Westpanamas. *Die Bromelie* 2011(2): 82–84.

Cáceres D, **Schulte K**, Schmidt M, Zizka G (2011b) A synopsis of the Bromeliaceae of Panama, including new records for the country. *Willdenowia* **41**: 357–369.

Cooper WE, de Boer HJ (2011) A taxonomic revision of *Trichosanthes* L. (Cucurbitaceae) in Australia, including one new species from the Northern Territory. *Austrobaileya* **8(3)**: 366–367.

Costion C, Ford A, Cross H, **Crayn D**, **Harrington M**, Lowe A (2011a) Plant DNA Barcodes can accurately estimate species richness in poorly known floras. *PLoS One* **6**: e268.

Givnish TJ, Barfuss MHJ, Van Ee B, Riina R, **Schulte K**, Horres R, Gonsiska PA, Jabaily RS, **Crayn DM**, Smith JAC, Winter K, Evans TM, Holst BK, Luther H, Brown GK, Till W, Zizka G, Berry PE, Sytsma KJ (2011a) Phylogeny and historical biogeography of Bromeliaceae: insights from an 8-locus plastid phylogeny. *American Journal of Botany* **98(5)**: 1–24.

Johnson KA, Holland BR, Heslewood MM, **Crayn DM** (2011) Supermatrices, supertrees and serendipitous scaffolding: Inferring a well-resolved, genus-level phylogeny of Styphelioideae (Ericaceae) despite missing data. *Molecular Phylogenetics and Evolution* (published online 22 Sept. 2011).

Karan M, Evans DS, Reilly D, **Schulte K**, Wright C, Innes D, Holton TA, Nikles DG, Dickinson GR (2011) Rapid microsatellite marker development for African mahogany (*Khaya senegalensis*, Meliaceae) using next-generation sequencing and assessment of its intra-specific genetic diversity. *Molecular Ecology Resources* (published online Sept. 2011)

Largent DL, **Abell-Davis SE** (2011) Observations on *Inocephalus virescens* and *Alboleptonia stylophora* from far north Queensland, Australia. *Mycotaxon* **116**: 231–245.

Largent DL, **Abell-Davis SE**, Cummings GA, Ryan KL, Bergemann SE (2011a) Saxicolous species of *Claudopus* (Agaricales, Entolomataceae) from Australia. *Mycotaxon* **116**: 253–264.

Largent DL, Bergemann SE, Cummings GA, Ryan KL, **Abell-Davis SE**, Moore S (2011b) *Pouzarella* (Agaricales, Entolomataceae) species from New South Wales (Barrington Tops National Park) and northeastern Queensland, Australia. *Mycotaxon* **117**: 435–483.

Nakamura K, Denda T, Kokubugata G, Forster PI, **Wilson G**, Peng C-I, Yokota M (2011) Molecular phylogeography reveals an antitropical distribution and local diversification of *Solenogyne* (Asteraceae) in the Ryukyu Archipelago of Japan and Australia. *Biological Journal of the Linnean Society* (published online Oct. 2011)

Papadopulos AST, Baker WJ, **Crayn D**, Butlin RK, Kynast RG, Hutton I, Savolainen V (2011) Speciation with gene flow on Lord Howe Island. *Proceedings of the National Academy of Sciences, USA* **108(32)**: 13188–13193.

Schneider JV, **Schulte K**, Aguilar JF, Huertas ML (2011) Molecular evidence for hybridization and introgression in the neotropical coastal desert-endemic *Palaua* (Malveae, Malvaceae). *Molecular Phylogenetics and Evolution* **60**: 373–384.

Tamla HT, **Cornelius JP**, **Page T**. (2011) Reproductive biology of three commercially valuable *Santalum* species: development of flowers and inflorescences, breeding systems, and interspecific crossability. *Euphytica* (published online 27 Sept. 2011).

Zich F, Ford AJ (2011) *Wilkiea kaarruana* Zich & A.J.Ford (Monimiaceae), a new species from north-east Queensland. *Austrobaileya* **8(3)**: 406–409.

Theses

Costion C (2011) The Australasian Floristic Interchange: Rainforest refugia, biogeography, and conservation in the Australasian tropics. PhD, University of Adelaide. Supervised by Prof A. Lowe and **Prof D. Crayn**.

Heller S (2011) Molecular analyses in *Aechmea* (Bromeliaceae) - the *Gravisia* complex [Molekulare Analysen der *Aechmea*-Verwandschaft (Bromeliaceae) – der *Gravisia* complex]. Diploma (MSc equivalent), Goethe University Frankfurt/M. Supervised by Prof G. Zizka, **Dr K. Schulte** and Dr B. Kanz.

Silvestro D (2011) Diversification in time and space: Methodological advancement and case studies from the Neotropical plant family Bromeliaceae. PhD Goethe University Frankfurt/M. Supervised by Prof G. Zizka and **Dr K. Schulte**.

Simpson L (2011a) Mind the Gap – Phylogeography and taxonomy of the *Dendrobium speciosum* complex (Orchidaceae). Honours, James Cook University. Supervised by **Dr K. Schulte**, Dr M. Clements (CANBR) and **Prof D. Crayn**.

**Result Class 1.

General Publications (unrefereed)

Hill R, Turpin G, Canendo W, Standley P, Crayn D, Warne E, Keith K, Addicott E, Zich F (2011) Indigenous-driven tropical ethnobotany. *Australian Plant Conservation* **19**(4): 24–25.

Schulte K (2011a) Natural hybrids in *Puya*. Popular web article. Published online at <http://www.bromeliopolis.com/content/natural-hybrids-in-chilean-puya/>

Phoon S-K (2011a) In the spotlight – *Elaeocarpus mastersii*. *Flora of Peninsula Malaysia Online Newsletter* **85/17**: posted Aug 19 2011.

Wilson GW (2011a) Drop in for a meal: investigating Australia's carnivorous pitcher plants. *Wildlife Australia* **48**(3): 20–23.

Wilson GW, Venter F, Wilson RF and Crayn D (2011) Chasing *Nepenthes* on Cape York, Queensland. *Carnivorous Plant Newsletter* **40**(4): 122–128.

Worboys S (2011a) Online Resources for Plant Identification. *Friends of Botanic Gardens Newsletter*.

Worboys S (2011b) Online Resources for Plant Identification. *Society for Growing Australian Plants Newsletter* Feb. 2011 issue.

Research Presentations

Baba Y (2011a) Systematics of *Elaeocarpus* in Australia. *Second National Postgraduate Training Workshop in Systematics, University of Adelaide, 25–30 Sept* [oral].

Butcher R, Byrne M, Crayn D (2011). So near, yet so far: evolutionary relationships among rare *Tetradlea* species endemic to banded ironstone ranges in Western Australia. *XVIII International Botanical Congress, Melbourne* [ePoster].

Cáceres D, Schulte K, Schmidt M, Zizka G (2011c) From herbarium specimen to conservation recommendation – the example of bromeliads (Bromeliaceae) in Panama. *Annual Conference of the Society for Tropical Ecology, Frankfurt (Germany)* [oral].

Costion C, Crayn D, Lowe A (2011b). Tree DNA barcoding of the Australian Wet Tropics: species delineation and diversity estimation. *XVIII International Botanical Congress, Melbourne* [oral].

Crayn D (2011) A scientific treasure trove – Banks and Solander's contribution to botany from Cook's first voyage. *Cooktown Symposium, Cooktown*.

Crayn D, Costion C, Harrington M (2011). Laurasian invasion? Phylogenetics and the origins of the Australian tropical rainforest flora. *XVIII International Botanical Congress, Melbourne* [oral].

Field A. (2011). Phylogeny and rarity in Australian tassel-ferns. *XVIII International Botanical Congress, Melbourne* [oral].

Givnish TJ, Barfuss MHJ, Van Ee B, Riina R, Schulte K, Horres R, Gonsiska PA, Jabaily RS, Crayn DM, Smith JAC, Winter K, Brown GK, Evans TM, Holst BK, Luther H, Till W, Zizka G, Berry PE, Sytsma KJ (2011b). Origin, phylogeny, adaptive radiation, and geographic diversification of Bromeliaceae. *XVIII International Botanical Congress, Melbourne* [oral].

Harrington M (2011) Evolution of the Australian flora - insights from molecular data. *ATFI Seminar Series, James Cook University, Cairns* [oral].

Heller S, Leme E, Schulte K, Zizka G (2011) The *Gravisia/Portea* complex (Bromelioideae, Bromeliaceae) – new insights from molecular studies. *XVIII International Botanical Congress, Melbourne* [ePoster].

Huertas ML, Schulte K, Fuertes J, Schneider JV (2011) Corroborating hybridization and introgression in *Palaua* (Malvaceae) using nuclear ITS and cellulose synthase DNA sequences. *BioSystematics 2011, Berlin (Germany)* [oral].

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Phoon S-N (2011b) Systematic studies in *Elaeocarpus* (Elaeocarpaceae) on Sundaland. *Kepong Herbarium seminar series, Malaysia* [oral].

Phoon S-N (2011c) A systematic study of *Elaeocarpus* (Elaeocarpaceae) on Sundaland. *Second National Postgraduate Training Workshop in Systematics, University of Adelaide* [oral].

**Won the Best Presentation for Session 1.

Puente-Lelievre C (2011) Systematics and biogeography of the Australian Ericaceae. *Second National Postgraduate Training Workshop in Systematics, University of Adelaide* [oral].

**Won the Best Presentation for Session 2.

Puente-Lelievre C, Harrington M, Hislop M, Quinn C, Brown E, Crayn D (2011). Phylogenetic relationships, tempo and patterns of evolution of the Australasian Ericaceae. *XVIII International Botanical Congress, Melbourne* [oral].

Schulte K, Silvestro D, Schmidt M, Winter K, Smith JAC, Crayn DM, Novoa P, Zizka G (2011a). CAM plasticity drives evolutionary success in tropical plants: a case study in Chilean *Puya* (Puyoideae, Bromeliaceae). *XVIII International Botanical Congress, Melbourne* [oral].

Schulte K (2011) Disentangling complex relationships in Australasian orchids. *Three minute research talk, Early Career Research workshop, James Cook University* [oral].

Schulte K, Silvestro D, Zizka G (2011b) A critical evaluation of AFLPs for taxonomic delimitation in recently evolved species: lessons from bromeliads. New research tools for illuminating the ecology and evolution of orchids. *A post-International Botanical Congress workshop, Royal Botanic Gardens Cranbourne* [oral].

Silvestro D, Wagner N, Schulte K, Weising K, Ibisch P, Nowicki C, Zizka G, Schnitzler J (2011a) A new Bayesian approach to estimate biogeography-related diversification rates: examples from *Fosterella* (Bromeliaceae) and *Lupinus* (Fabaceae). *XVIII International Botanical Congress, Melbourne* [oral].

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Simpson L (2011b) Resolving taxon limits in the contentious *Dendrobium speciosum* complex (Orchidaceae): a molecular approach. *Honours introductory seminar, James Cook University, Cairns* [oral].

Simpson L (2011c): Mind the gap – phylogeography and taxonomy of the *Dendrobium speciosum* complex (Orchidaceae). *Honours exit seminar, James Cook University, Cairns [oral]*.

Turpin G (2011) Indigenous-driven ethnobotany project. *Vegetation survey and regional ecosystem workshop, Brisbane [oral]*.

Weising K, Schütz N, Wagner N, Krapp F, Blank S, Zizka G, Michalak I, Silvestro D, Ibsch P, **Schulte K** (2011) Phylogeny and evolutionary history of Pitcairnioideae s. str. (Bromeliaceae) inferred from chloroplast and nuclear data. *XVIII International Botanical Congress, Melbourne [oral]*.

Wagner N, Michalak I, Silvestro D, Zizka G, **Schulte K**, Weising K (2011) Evolution in the Central Andes: phylogeny and phylogeography of *Fosterella* (Pitcairnioideae, Bromeliaceae). *XVIII International Botanical Congress, Melbourne [oral]*.

Wagstaff SJ, Dawson MI, Venter S, Munzinger J, **Crayn DM**, Steane DA, Lemson KL (2011). Dragons in the mist: origin, dispersal and diversification of the Australasian genus *Dracophyllum* (Richeeae, Ericaceae). *XVIII International Botanical Congress, Melbourne [oral]*.

Wilson GW (2011b) The ecology, systematics and biogeography of the Austro-Papuan *Nepenthes* pitcher plants. *PhD Confirmation seminar, James Cook University, Cairns [oral]*.

Wilson GW (2011c) Carnivorous plants and crocodiles - chasing *Nepenthes* on Cape York. *ATFI seminar series, James Cook University, Cairns [oral]*.

Wilson GW (2011d) The ecology, systematics and biogeography of the Austro-Papuan *Nepenthes*. *Second National Postgraduate Training Workshop in Systematics, University of Adelaide [oral]*.

Wilson GW (2011e) The ecology, systematics and biogeography of the Austro-Papuan *Nepenthes*. *XVIII International Botanical Congress, Melbourne [ePoster]*.

Community Talks

Baba Y (2011b) Diversity and phylogenetics of Australian quandongs. *Friends of the Botanic Gardens, Cairns*.

Wilson GW (2011f) Reproduction in the forest. *Interpretative Walk at Cairns Botanic Gardens*.

Wilson GW (2011g) Of birds, butterflies and biogeography: the story of evolution. *Inaugural Public Lecture, Cairns Botanic Gardens Visitor Centre*.

Worboys S (2011c) New online resources for plant identification in the Wet Tropics. *Friends of the Botanic Gardens, Cairns*.

Worboys S (2011d) New online resources for plant identification in the Wet Tropics. *University of the Third Age (U3A), Cairns*.

Income

External Competitive Research Grants

Total research grant income was **\$409,867**. Funding sources included the Australian Biological Resources Study (ABRS), Australian Centre for International Agricultural Research (ACIAR), Australian Research Council, Conservation International, German Development Bank (KfW), Hansjorg Eichler Scientific Research Fund of the Australian Systematic Botany Society, National Environmental Research Program (NERP), Queensland Departments of Environment and Resource Management (DERM), and Primary Industry and Fisheries (DPIF), Skyrail Rainforest Foundation, Wildlife Preservation Society of Queensland.

Fees for Service

ATH charged external clients **\$17,547** in service fees. This included Plant ID workshop fees (\$11,841), herbarium access fees (\$4,576), specimen identification service fees (\$1130), advisory board sitting fees (\$405) and editorial board fees (\$200).

Below: *Ipomoea pes-caprae*, a common tropical beach creeper. Image: Andrea Lim.
Right: The curtain fig tree (*Ficus virens*), near Yungaburra. Image: Andrea Lim



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¹ together contribute one Molecular Systematist position

² together contribute one Laboratory Manager position



Long-standing volunteer Murray Borrell.

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Eloise Wigger
Heather Winsor



Four of our most long-standing volunteers: (L-R) Nanette Fairbairn, Mary Gandini, Nada Sankowsky and Garry Sankowsky. Image: Andrea Lim.



Bulbophyllum gadgarrense or Tangled Rope Orchid, Image: Andrea Lim

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