Australian Tropical Herbarium

ATH
Australian Tropical Herbarium

DIRECTOR'S SUMMARY 2008

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.

Cover photo: *Amyema whitei* by Andrea Lim.

Contents

Above: Lake margin, inset: ATH Director Darren Crayn with the Collection.

From the Director

The year 2008 marks the inaugural year of the Australian Tropical Herbarium. It has a been a hectic but highly rewarding year that has seen the ATH develop into a coherent tropical plant biodiversity research institution with a growing national and international profile. Our focus this year has overwhelmingly been on activities associated with establishment of the institution such as building our team, developing institutional policies and procedures, founding and reinforcing links with our stakeholders at all levels including with the Participants in the ATH joint venture – CSIRO, James Cook University and the Queensland Government – and like-minded institutions and researchers nationally and internationally. This has been achieved through our membership of the Council of Heads of Australasian Herbaria (CHAH), through hosting visits by relevant VIPs such as the Queensland Premier the Hon. Anna Bligh and the Federal Treasurer the Hon. Wayne Swan, through teaching and mentoring tertiary students, through opening our facilities to visiting scientists and also to the public on open days, and by publicising the ATH's activities through the media.

With much of the business of establishing the ATH completed, we expect to shift the focus in 2009 to research and collections development. We have three new graduate students beginning research projects, two postdoctoral researchers coming on board, and a newly completed state-of-the-art molecular genetics lab. A number of external funding proposals for new projects are currently under consideration and if successful will open up exciting new opportunities for innovative research at the ATH.

The ATH team are very much looking forward to continuing to build the Australian Tropical Herbarium into a leading international tropical plant and fungal biodiversity research institution.

Professor Darren Crayn
Director, Australian Tropical Herbarium

Introduction

Queensland Premier, Anna Bligh and MPs Steve Wettenhall and Desley Boyle with Director, Darren Crayn, at the official opening of the Australian Tropical Herbarium in March 2008.

The Australian Tropical Herbarium (ATH) is a joint venture of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Director National Parks (DNP), Queensland Environmental Protection Agency (Qld EPA), Queensland Department of Trade, Regional Development and Industry (DTRD&I), 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 EPA) and an independent chair. The ATH is physically located within the Australian Tropical Forest Institute (ATFI) on the Cairns campus of JCU, and administratively within JCU's Faculty of Science and Engineering (FSE).

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 covers a range of topics including tropical plant and fungal taxonomy and evolution, ethnobotany, ecology, climate change studies, development of identification products, agroforestry and regional ecosystem mapping.

The first activity of the ATH was the appointment of Mr Frank Zich as Curator of QRS in Nov 2006. The Sir Robert Norman Building (housing ATFI and the ATH) was completed in November 2007. Permission to occupy the new building was granted at the start of December and the MBA collection moved soon thereafter. The bulk of the QRS collection was moved over the 10 days prior to Christmas, and completed by the start of February 2008. The building was opened by the Hon. Anna Bligh, Premier of Queensland on the 4th of March 2008. The inaugural Director commenced duty on the 31st of March 2008, the Operational Date of ATH.

JAMES COOK UNIVERSITY AUSTRALIA

Queensland Government

CSIRO

Australian Government
Director of National Parks

2008 Achievements

Publications (including media)

Key Performance Indicator (KPI) Target: Five refereed scientific papers/articles published in leading national or international journals, refereed conference papers, books or book chapters on average per annum

Publications by ATH staff in 2008 for general and scientific audiences are detailed below (ATH staff in boldface).

Regional Ecosystem map sheets:

Neldner VJ, **Addicott E, Newton M, Bannink, P.** (2008) Vegetation Communities and Regional Ecosystem 1:100,000 Survey and Mapping of the Cape York Peninsula Bioregion and Gulf Plains Bioregion: Hann River 1:250,000 map sheet.

Turpin G. (2008) Vegetation Communities and Regional Ecosystem Survey and Mapping of the Channel Country Bioregion: Tickalara 1:250,000 map sheet. GIS support **P. Bannink.**

Scientific papers (refereed):

Guariguata M, **Cornelius JP,** Locatelli B, Forner C, Sánchez-Azofeifa GA. (2008) Mitigation needs adaptation: tropical forestry and climate change. *Mitigation and Adaptation Strategies for Global Change* 13: 793-808.

De la Torre A, López C, Yglesias E, **Cornelius JP.** (2008) Genetic (AFLP) diversity of nine *Cedrela odorata* populations in Madre de Dios, southern Peruvian Amazon. Forest Ecology and Management 255(2): 334-339.

Maynard D, **Crayn D,** Rossetto M, Kooyman R, Coode M. (2008) *Elaeocarpus sedentarius* sp. nov. (Elaeocarpaceae) – morphometric analysis of a new, rare species from northeastern New South Wales. *Australian Systematic Botany* 21:192-200.

Articles (unrefereed):

Crayn DM. (2008) Recent developments in plant DNA barcoding. *Australian Systematic Botany Society Newsletter* 134: 6-7.

Crayn DM. (2008) The Australian Tropical Herbarium – open for business! *Australian Systematic Botany Society Newsletter* 134: 11-13.

Scientific seminars, posters and talks:

Addicott E. (2008) QLD Regional Ecosystem Survey and Mapping Project: A Northern Savanna Perspective. Australian Tropical Forest Institute seminar series, JCU, Cairns.

Bannink P. (2008) Mapping Regional Ecosystems, a GIS perspective. FUNGIS seminar series. Cairns.

Crayn DM. (2008) The Australian Tropical Herbarium. Australian Systematic Botany Society Conference, Adelaide, SA, Australia [poster].

Crayn DM. (2008) The Australian Tropical Herbarium. JCU Public Lecture series, Cairns.

Crayn DM, Rossetto M. (2008) Patterns of phenotypic and genotypic variation in some Australian *Elaeocarpus* (Elaeocarpaceae). Australian Systematic Botany Society Conference, Adelaide, SA, Australia.

Givnish T, Van Ee B, Riina R, Barfuss M, Schulte K, Horres R, Gonsiska P, **Crayn D,** Smith A, Winter K, Brown G, Evans T, Holst B, Luther H, Till H, Zizka G, Berry P, Sytsma K (2008) Adaptive radiation and diversification in Bromeliaceae: insights from a new multi-locus phylogeny. Monocots IV Conference, Copenhagen Denmark.

Heslewood MM, **Crayn DM,** Rossetto M, Lowe AJ (2008) Phylogenetic relationships of *Ceratopetalum* (Cunoniaceae). Australian Systematic Botany Society Conference, Adelaide, SA, Australia.

McPherson H, Rossetto M, **Crayn DM,** Gross CL (2008) Evolutionary patterns in *Tetratheca* (Elaeocarpaceae) from eastern Australia. Australian Systematic Botany Society Conference, Adelaide, SA, Australia.

Zich F (2008) Australian Tropical Rainforest Plants – an interactive identification system. Australian Systematic Botany Society Conference, Adelaide, SA, Australia [poster].

Four print articles and one local TV news story reported on the establishment of the ATH and provided general information on its facilities and programs. Other media exposure included the July 16 Public Lecture at JCU, the August 28 Wayne Swan/Jim Turnour TV interview, and the December 1 Public Reference Collection opening (radio and print).

Citations

KPI Target: Ten citations per annum in international journals.

The first article authored by ATH staff appeared in late 2008. The first citation is therefore not expected until late 2009.

PhD and Honours student numbers

KPI Target: For the first three years of the Term, enrol one Doctoral and Masters Degree student on average per annum, including 0.5 Queensland graduates/ 0.5 overseas graduates.

New enrollments:
Mr Craig Costion, Univ. Adelaide, PhD, supervisors Prof. A. Lowe (U.Adel.), Prof. D. Crayn. Project: 'Phylogenetic diversity analysis of the Australian Wet Tropics flora'.

Continuing students:
Ms Hannah McPherson, Univ. of New England, PhD, supervisors Dr M. Rossetto (Royal Botanic Gardens Sydney), Prof. D. Crayn, Prof. C. Gross (UNE). Project: 'Phylogenetics and evolutionary dynamics of *Tetratheca* (Elaeocarpaceae)'

Ms Margaret Heslewood, Univ. of Adelaide, PhD, supervisors Dr M. Rossetto (Royal Botanic Gardens Sydney), Prof. D. Crayn, Prof. A. Lowe (U.Adel). Project: 'Phylogeography and biogeography of the family Cunoniaceae in Australasia'

Research Income to Joint Venture (cash and in-kind)

*KPI Target: For the first three years of the Term, secure **$30000** of competitive or peer reviewed research grants on average per annum where research or technical staff attached to ATH are the principal researchers/technicians. For the first three years of the Term, secure **$15000** external grants or donations on average per annum for research where research or technical staff attached to ATH are the principal researchers/technicians.*

1. Part salary for Postdoctoral Fellow for 1 year (c. $57,000) and $20,000 research funds. This is a 3 year, 3-way co-funding agreement between ATH/JCU, Royal Botanic Gardens Sydney (RBG), and the Australian Biological Resources Study (ABRS). ATH will host the Fellow for a negotiated proportion of the final year (2010-11), with JCU Faculty of Science and Engineering contributing $25,000 in that year, a net income to ATH of $77,000. Project title: Integrating molecular and morphological data for generic delimitation and species identification in Lauraceae. Prof. Darren Crayn and Drs Maurizio Rossetto and Peter Weston (RBG).

2. Three year Australian Biological Resources Study research grant (2008-11) including PhD scholarship (c. $20,000 pa) and research funds (c. $12,000 pa), total $96,000 over 3 years. JCU will enrol the student and ATH will host the project for its entire duration. Project: A revision of generic limits within the *Astroloma-Styphelia* clade and an assessment of the phylogeny of Styphelioideae. Prof. Darren Crayn and Dr Elizabeth Brown (RBG).

NOTE: These grants were applied for prior to the ATH Directorship being advertised and won since Operational Date. The terms have been renegotiated such that ATH will host the projects for part or the entire duration.

Number of Postdoctoral Fellows

KPI Target: Employ 2.5 postdoctoral fellows on average per annum.

Two Postdoctoral Fellow positions (co-funded by JCU and CSIRO) were advertised in late December. Appointments will take place in 2009.

Number of Visiting Scientists

KPI Target: Twenty visiting national and international scientists on average per annum.

ATH hosted fifty one research visits by fourteen scientists during the reporting period. Other visitors to ATH included 10 from other universities, 79 from QLD government departments, 16 TAFE students, one group of 22 JCU students, one group of 47 school students, and one group of 23 local science teachers and school principals. VIP visitors included **Federal Treasurer Wayne Swan** (group of 12), a US Trade Delegation (15), a military delegation (13), Uniquest (JCU's commercialisation partner) (4), and the Skyrail Board (5).
JCU Open Day on August 17 was very well received, with 150 persons attending the tours of the Herbarium. On December 1 **Dr Les Hiddins (the 'Bushtucker Man')** launched the Public Reference Collection, with 55 invitees representing key stakeholder groups in attendance.

Sir Robert Norman building at James Cook University, Cairns Campus, housing the Australian Tropical Herbarium and the Australian Tropical Forest Institute.

Number of Collaborative Projects

KPI Target: By the 3rd anniversary of the Operational Date, enter into minimum one local, one national, and one international multidisciplinary, collaborative projects on average per annum with research and industry or business partners.

Commenced

Five collaborative projects commenced during the reporting period: one with JCU staff (Influence of climate change on phenology of tropical rainforest plants), one with a local naturalist and landholder (Plant Diversity of Mt Spurgeon), two with national partners (Phylogenetic Diversity of the Wet Tropics Flora; Systematics and Evolution of Styphelioideae) and one with national and international partners (Origins, Evolution and Molecular Identification of Lauraceae).

In Progress

Eighteen projects were active during the reporting period (see 'Research' section for details)

Completed

One project was completed during 2008 (Ecology of Truffles).

Collection maintained to established international standards

KPI Target: Collection maintained at high level of curation – >90% specimens with accurate and reliable names. 100% of the collection databased and available electronically. Collection to be free of any pest infestations. New accessions to be processed and incorporated within 12 weeks of receipt. Loan requests fulfilled within 4 weeks of receipt.

In preparation for the merging of the collection database with the CPBR database, approximately 1200 name records have been edited to conform with APNI/IPNI spelling and the HISPID phrase name format. Taxonomic and nomenclatural changes appearing in the literature since late 2007 or on the Australian Plant Census web site are yet to be applied. No pest outbreaks were detected. Approx. 8000 Orchidaceae specimens donated by Alex Dockrill are yet to be processed and remounted. Approx. 1000 new collections and exchange specimens, mostly QRS holdings carried over to CNS, require processing. The draft Collection Operating Protocol has been completed and drafting of a disaster action plan commenced. Due to the move and migration of the collection database no new accessions were completed in 2008, and dispatch of duplicates has been less than normally expected because of the inability to produce specimen labels:

- Outgoing Loans – 4 loans, 32 specimens
- Outgoing Exchange – 4 consignments, 6 specimens
- Incoming Exchange – 5 consignments, 272 specimens
- Returned Loans – 4 consignments, 23 specimens

Dawsonia polytrichoides, photo: Paul Gadek.

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. 150,000 specimens that are pressed, dried and mounted on herbarium sheets held in the Collection Room*
- *c. 16,000 specimens that are pickled in 70% ethanol held in the Spirit Room*
- *c. 2500 wood blocks*

In early 2008 relocation of the collections from Atherton Herbarium (QRS) and Mareeba Herbarium (MBA) was completed. Final cleaning and sorting was completed soon after. The MBA collection has been fully integrated and the Index Herbariorum code 'CNS' established for the merged collection. A draft Collection Operating Protocol was completed and will be updated as necessary. General membership of the Council of Heads of Australasian Herbaria (CHAH) was granted. Use of the herbarium by scientific visitors totalled142 hours. Seventeen volunteers were recruited who donated 869 hours and mounted 1850 specimens.

Public Reference Collection

The Public Reference Collection (PRC) consists of a collection of herbarium specimens, literature, interactive CD keys and other resources for identifying plants. It exists primarily as a resource to enable the public, consultants, and other interested persons to identify their own collections.

The JCU Cairns student reference set of approx. 938 taxa (981 specimens) formed the foundation of the ATH PRC. Some 1314 taxa (1948 specimens) of undistributed QRS duplicates were set aside to add to the PRC, and volunteers have mounted 1850 of these specimens. At the end of 2008, the PRC contained 1971 taxa. Collection of taxa to address the remaining gaps can now commence. The estimated ultimate size of the ATH PRC is > 4000 taxa.

The PRC was publicly launched by the 'Bush Tucker Man', Dr Les Hiddins at a ceremony on December 1 attended by 55 guests including JCU Chancellor Lt. Gen John Grey (ret.) and Vice Chancellor Prof. Sandra Harding. Local print and radio media reported the event.

Visitor use of the PRC totalled 69 hours.

Specimen Database

The ATH collections are fully databased and will soon be hosted in the Oracle databases at the Centre for Plant Biodiversity Research (CPBR) in Canberra and accessible by all ATH staff via secure internet link for data entry, query and reporting. Web access, with password protection, will also enable public query and reporting on data. Records will also be visible through the Australia's Virtual Herbarium.

Data validation was undertaken in late 2008, prior to the integration of the ATH data with CPBR's in 2009. Validation revealed approximately 1200 incorrect names, mostly spelling errors. These records have been corrected with reference to the original specimen. Databases associated with the Rain Forest Key currently maintained in FoxPro have been transferred to MSAccess.

ATH Director, Darren Crayn, with pickled specimens held in the Spirit Room.

Library

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

During 2008 two private specialist libraries were donated. One, a tropical biology collection bequested by Garry Werren has been partially incorporated and curated. The other, a fungi library donated by the North Queensland Chapter of the Australasian Mycological Society is yet to be assessed.

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, genotyping using a range of techniques from RFLPs to microsatellite analysis, and in the future, genomics. At capacity the lab caters for 6-8 researchers and students.

Activity in 2008 was dominated by the purchase and installation of equipment to fitout the lab - completion is expected in early 2009.

DNA and Tissue Bank

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

In 2008 our bank contained c. 1300 DNA and tissue samples representing c. 50 families and c. 980 species.

Calamus moti, inset: *Calamus moti* fruit, photos: Gary Wilson.

Research

Research at the Australian Tropical Herbarium falls into the following five themes:

- **Theme 1 – Biodiversity, Taxonomy, Evolution**
  Assessment of tropical plant biodiversity through tropical plant and fungal 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 – New Uses For Flora**
  Innovative utilisation of tropical plant and fungal resources, such as biodiscovery and bioprospecting, novel crops and commercialisation;
- **Theme 4 – Planning And Management**
  Planning and management of tropical flora, or 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.

Details of research undertaken by ATH staff during 2008 under each of these themes is provided below.

Theme 1 – Biodiversity, Taxonomy, Evolution

DNA-Barcoding tropical Australian trees

DNA-Barcoding is the use of short, standardised DNA sequences to identify biological material. A global movement is progressing research on two major fronts: (1) developing the reference database of DNA-barcodes from all life, and (2) building a handheld DNA-barcode reader to allow anyone to identify any life form, anywhere.

Prof. Crayn was invited to act as one of three Australasian coordinators for an ambitious long term global project to DNA barcode the trees of the world. This project, funded partly by the Sloan Foundation and led by the New York Botanical Garden, is the flagship plant DNA barcoding project. ATH's commitment to this project is to barcode the Australian tropical rainforest trees. Progress in 2008 toward this goal included collection of vouchered inner bark and/or leaf samples from c. 290 taxa for DNA extraction. These samples will be processed and selected loci sequenced in 2009.

Research Team: Prof. Darren Crayn (ATH), Prof. Brett Summerell (National Herbarium of NSW), Prof. Andy Lowe (Univ. Adelaide, State Herbarium of South Australia), Dr Hugh Cross (Univ. Adelaide).

Ecology of Truffle Fungi

This project examined the distribution of truffle fungi in the Wet Tropics, which are the principal food resource of the endangered specialist mycophagous (fungus eating) marsupial, Bettongia tropica.

This long-term study on hypogeous (below-ground fruiting) fungi, commonly known as truffles was completed in 2008. *Bettongia tropica* are thought to be restricted to habitats where seasonal availability of truffles remains high. The habitat restriction of the endangered *B. tropica,* within a narrow band of ecotonal sclerophyll vegetation along the western margin of wet tropical rainforests in North Queensland Australia, was found to be attributed to the availability of their critical food resource (truffle fungi) in both time and space.
A total of 49 species from 1161 truffle samples collected throughout this study will be deposited in the ATH herbarium. One third of those species are new to science and await taxonomic description.
Research Team: Sandra Abell-Davis (PhD candidate, JCU and ATH), Prof. Paul Gadek (ATH).

Phylogenetics and evolutionary dynamics of Elaeocarpaceae

The phylogenetics, biogeography and within-species genetic diversity in Elaeocarpaceae, a worldwide family of over 500 species in 12 genera, is being studied. Molecular phylogenetic and biogeographic studies are being used to clarify origins and patterns of diversification among lineages within the Elaeocarpaceae/Tremandraceae complex. Within the phylogenetic framework, we are analysing population-level genetic diversity in selected species in order to provide an insight into comparative evolutionary responses and speciation mechanisms in dry-adapted shrubs and rainforest tree species.

Progress during 2008 included publication of one paper (Maynard et al. 2008) describing a new species of *Elaeocarpus* from northeastern NSW, submission of a second paper, a PhD student completion (Ms Hannah McPherson PhD thesis - "Phylogenetics and Evolutionary Dynamics of *Tetratheca* (Elaeocarpaceae)"), presentation of findings at an international conference, and attracting a potential PhD student (Ms Yumiko Baba has proposed to begin a PhD program in 2009 on a taxonomic and biogeographic study of SE Asian *Elaeocarpus* (Elaeocarpaceae) under the supervision of Prof. Crayn and Prof. Gadek).
Research Team: Prof. Darren Crayn (ATH), Dr Maurizio Rossetto (National Herbarium of NSW), Hannah McPherson (National Herbarium of NSW), Dr Mark Coode (Kew Gardens, UK), Robert Kooyman (Macquarie University).

Phylogeny and population dynamics of Cunoniaceae

Cunoniaceae is a family of mostly rainforest trees thought to be of Gondwanan origin. This project investigates the origins and evolution of the family and in particular the genus Ceratopetalum *using dated molecular phylogenies for* Ceratopetalum *species to evaluate the role of long distance dispersal and vicariance in explaining present distributions. Furthermore, present day genetic structure and geographic distribution of* Ceratopetalum *species will be determined to infer the strength and directions of gene flow within and between populations for each taxon.*

Progress on this project during 2008 included establishment of appropriate DNA markers for phylogenetic work, and collection of additional samples

Researchers conduct mapping fieldwork.

"A total of 49 species from 1161 truffle samples collected...will be deposited in the ATH...one third of those species are new to science..."

of *Ceratopetalum gummiferum* for population genetic work. A phylogenetic investigation of the Cunoniaceae is well underway using chloroplast and nuclear loci. Fossil data are being compiled for dating analysis. Sequence data for the Australian taxa is being contributed to a global molecular phylogenetic project on Cunoniaceae. Hierarchical analyses of phylogeography (comparative analysis across *Ceratopetalum*, 9 taxa) and population genetics (from within to between population structuring of *Ceratopetalum apetalum*) is now also well advanced for this group, and developed microsatellite primers have been published.
Research Team: Margaret Heslewood (PhD student, National Herbarium of NSW and Univ. Adelaide), Dr Maurizio Rossetto (National Herbarium of NSW), Prof. Darren Crayn (ATH), Prof. Andy Lowe (Univ. Adelaide, State Herbarium of South Australia), Johan Pillon (Institut de Recherche pour le Developpement, New Caledonia).

Phylogenetic diversity analysis in the Wet Tropics flora
This study will investigate, using a plot based approach, the relative performance of taxonomic diversity (species counts) and phylogenetic diversity (branch lengths on molecular phylogenies) measures for conservation priority setting. This project is aligned with the tropical tree DNA-barcoding project and data will contribute to both projects.

Progress in 2008 included four 0.5 hectare plots sampled, one 0.1 hectare plot sampled, and four separate collection trips, which together yielded approx. 400 vouchered specimens with tissue samples for DNA extraction representing approx. 290 species in 180 genera from the wet tropics bioregion.
Research Team: Craig Costion (PhD student, Univ. Adelaide and ATH), Prof. Andy Lowe (Univ. Adelaide, State Herbarium of South Australia), Prof. Darren Crayn (ATH), Dr Dan Metcalfe (CSIRO), Andrew Ford (CSIRO).

Phylogenetics and the evolution of ecophysiological traits in Bromeliaceae
This multidisciplinary project aims to clarify the evolution of key ecophysiological traits, such as Crassulacean acid metabolism (CAM) in the bromeliads and relatives. 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.

Progress included submission of Crayn's sequencing load toward the multigene phylogeny subproject and presentation of the results at an international conference. A publication is currently being prepared.
Research Team: Prof. Darren Crayn (ATH), Prof. Andrew Smith (Univ. of Oxford, UK), Dr Klaus Winter (Smithsonian Tropical Research Institute, Panama), Dr Walter Till (Botanical Institute, Vienna, Austria), Prof. Thomas Givnish (Univ. Wisconsin, USA), Prof. Georg Zizka (Senckenberg Institute, Germany).

Systematics and evolution of Styphelioideae (Ericaceae)

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 will be a priority.*

Progress included securing a 3-year research grant (2008-11) including PhD scholarship. Initial difficulty attracting a student to the PhD scholarship was overcome and Ms Caroline Puente-Lelievre will commence in 2009 under the joint supervision of Prof. Crayn and Prof. Gadek. Initial work will focus on testing and selecting loci appropriate for the question.
Research Team: Prof. Darren Crayn (ATH), Dr Elizabeth Brown (National Herbarium of NSW), Mike Hislop (Western Australian Herbarium), Dr Chris Quinn (National Herbarium of NSW).

Origin and diversification of *Dracophyllum* (Ericaceae)

The genus Dracophyllum *contains cushion plants, shrubs and small trees distributed in Australia and the SW Pacific. We are investigating evolutionary processes that have contributed to the disparity in species richness and diversity seen between Australia and the archipelagos of New Zealand and New Caledonia.*

Data analysis and interpretation on this project was completed and a paper submitted in late 2008. In our analysis the Western Australian genus *Sphenotoma* (c. 7 species) forms a distinct evolutionary lineage that diverged from *Dracophyllum* (c. 50 species) and *Richea* (11 species) during the Miocene. We recovered two distinct lineages of *Richea* recognised as *Richea* sect. *Cystanthe* and *R.* sect. *Dracophylloides;* these were nested within *Dracophyllum*. The New Caledonian and New Zealand species of *Dracophyllum* arrived by long-distance dispersal during the Pliocene. Low levels of sequence divergence suggest a rapid and relatively recent species radiation in these two island archipelagos – in New Zealand this accompanied Pliocene uplift of the Southern Alps and episodes of glaciation during the Pleistocene.
Research Team: Dr Steve Wagstaff (Landcare Research, NZ), Dr Murray Dawson (Landcare Research, NZ), Dr Fanie Venter (ATH), Prof. Darren Crayn (ATH), Dr Kristina Lemson (Edith Cowan University, Western Australia), Dr Jerome Munzinger (Institut de Recherche pour le Developpement, New Caledonia), Dr Dorothy Steane (Univ. of Tasmania).

Origins, evolution and molecular identification of Lauraceae

Lauraceae is a large, globally distributed plant family of about 3000 species, mostly rainforest trees. This project aims to improve our understanding of the origins and evolution, and revise the taxonomy if necessary, of this family (focusing on the subfamily Cryptocaryeae) by conducting: (1) phylogenetic, divergence-time and historical biogeographical analyses; (2) phylogeographic studies on selected taxa to determine species limits and the relative importance of vicariance vs. dispersal in species radiation in Lauraceae. Furthermore, a DNA-barcode database for Cryptocaryeae will be developed.

With the generous field assistance of Rob Kooyman substantial progress have been made with the collection of species from NSW. Multiple collections were also made for four species - *Beilschmiedia obtusifolia, Cinnamomum oliveri, Endiandra discolor and Neolitsea dealbata* - that will be studied at population level. Preliminary phylogenetic analysis of the cpDNA region *psbA-trnH* for c. 60 species (most of them Australian) suggests that *Cryptocarya* is monophyletic while the paraphyletic status of *Endiandra* and *Beilschmiedia* globally and also amongst the Australian accessions is confirmed. We found that little sequence variation resides within the currently sequenced cpDNA regions (*psbA-trnH* and *matK*) and further molecular markers are required to unravel species level relationships.
Research Team: Dr Marlien van der Merwe (National Herbarium of NSW), Prof. Darren Crayn (ATH), Dr Maurizio Rossetto (National Herbarium of NSW), Dr Henk van der Werff (Missouri Botanical Garden), Dr Peter Weston (National Herbarium of NSW).

Plant Diversity of Mt Spurgeon

The plant diversity of Mt Spurgeon is being studied. Mt Spurgeon is a central feature of the floristically poorly known Carbine Tableland located c. 15 km W of Mossman (145º 14' E, 16º 26' S) which preserves contiguous savanna, rainforest and ecotonal habitat.

Preliminary development of the project has been completed (with Peter Cooper, naturalist and Mt Spurgeon landowner). Records of collecting activity on Mt Spurgeon have been compiled from the

DNA Bank.

Above: Native Wild Rice *Oryza australiensis,* photo: Gary Wilson. Inset: Public Reference Collection.

Queensland Herbarium and the ATH, preliminary site reconnaisance for base camp establishment has been conducted and the project plan development is well advanced.

Systematics and Ecology of Fungi

Mycology, the study of fungi, is an understudied field worldwide. Mycology in the wet tropics bioregion of far north Queensland has been especially neglected. There is a current surge in interest both nationally and internationally for research to be carried out within the wet tropics bioregion. One of the aims of the ATH is to facilitate and expand mycological research and collections within this region.

In 2008 Professor Emeritus David Largent (Humboldt University, California, USA) an international expert on pink, angular-spored, gilled mushrooms (Entoloma), visited. Being astounded at the diversity of the rainforest and the few mushrooms that could be found even at that time of the year (dry season), a return trip was organised for the end of the wet season in 2009. A conference is being organised for national and international mycologists in far north Queensland for February 2009, to coincide with Prof. Largent's return. During the five-day conference - FNQ Mycoblitz 2009 - five teams of expert and amateur mycologists will survey the vegetation of the wet tropics for micro and macrofungi. The focus will be on the six team leaders' fields of taxonomic expertise including:

- Sandra Abell-Davis James Cook University: Truffles
- Nigel Fechner Queensland Herbarium: Coral fungi
- Dr. Roger Shivas Plant Pathology Herbarium Brisbane: Rusts/smuts
- Adj. Assoc. Prof. Elaine Davison Curtin University: Slime moulds
- Dr. Roy Halling New York Botanic Gardens: Boletes
- Prof. Emeritus David Largent: *Entoloma*.

This conference will be the first biennial fungal foray for the wet tropics bioregion.

Theme 2 – Threats and Impacts

Influence of climate change on phenology of tropical rainforest plants

Possible effects of climate change on the timing of life history events (phenology) in tropical rainforest plants is being studied by monitoring the flowering and fruiting times of selected tree species over a ten-year period.

The research team led by Dr Mike Liddell (JCU) has established the research site, taxa to be studied and the methodology for this study. ATH's contribution will be identification and vouchering of study taxa.

Theme 3 – New Uses for Flora

Agroforestry

The Agroforestry and Novel Crops Unit (ANCU) of James Cook University aims to enhance tropical livelihoods through sustainable use of plant biodiversity, with an emphasis on the Pacific region and Far North Queensland. ANCU staff are affiliated with the ATH. ANCU has two principal research foci: participatory tree domestication (genetic improvement and product development), and deployment of superior material in multifuctional agroforestry systems. During 2008, notable advances have been made in the Unit's RfD projects in Papua New Guinea, Queensland, and Vanuatu.

In PNG, ANCU, with research partner NARI (the National Agricultural Research Institute), is working on domestication of galip-nut (*Canarium indicum* (Burseraceae)), a widely-consumed local nut species. NARI completed collection of nut samples from five provinces. Preliminary analysis suggests that phenotypic variation is greater within- than between-populations or regions. Using methods developed by ANCU staff members, NARI successfully propagated elite material of galip-nut for use by smallholder farmers; there is no previous published report of successful vegetative propagation of the species. Development of the galip-nut industry is an important alternative in cocoa-producing provinces such as East New Britain, due to the continuing spread of the cocoa pod borer.

In Vanuatu, ANCU, in partnership with the national Forestry Department, completed an inventory of the wild sandalwood resource. This will provide a basis for setting future sustainable harvesting quotas, as well as orienting germplasm collection strategies for both conservation and improvement. In addition, the first stages of a socioeconomic study of the sandalwood industry in Vanuatu were completed. The study is aimed principally at identifying the conditions for a successful industry based on sustainable production in agroforestry systems. Natural populations of sandalwood are currently endangered due to unsustainable whole-tree extraction.

In North Queensland, ANCU began pioneering research in agarwood silviculture, focusing on vegetative propagation and fertiliser response. In addition, it completed establishment of a trial noni (*Morinda citrifolia*) commercial orchard in Pormpuraaw, and also carried out complementary training activities.

Research Team: Dr. Jonathan Cornelius (ATH, JCU), Dr Tony Page (ATH, JCU), Anton Lata (PhD candidate, JCU), and research associate Anna Potrawiak.

Ethnobotany

Research is being undertaken into the ways in which indigenous peoples of the northern Australian region use plants for cultural practices, shelter, food, medicine, fibre, etc.

This is a new programme for the Australian Tropical Herbarium and under active development. Work to date has been focused on establishing contacts with the Barbarrum, Hopevale and Wujal Wujal communities in particular. Major field trips to Northern Territory and South Australia have been completed. A project to document the traditional names, uses and medicinal values of plants in the Cape Flattery - Hopevale area has commenced. A collaborative project with CSIRO aims to improve understanding of the reasons behind the failure of agroforestry projects in indigenous communites within the Wet Tropics World Heritage Area.
Research Team: Mr Gerry Turpin (ATH), Mr Fanie Venter (ATH).

Theme 4 – Planning and Management

Regional Ecosystem Mapping

As part of the Queensland Herbarium's State-wide Regional Ecosystems Mapping Programme, ATH staff are mapping (at 1:100,000 scale) for Cape York Peninsula and Einasleigh Uplands bioregion and parts of the Channel Country bioregion and the Gulf Plains bioregion. Mapping and survey is being done in blocks of 1:250,000 scale map sheets.

During 2008 the Hann River 1:250k map sheet was completed. Work on the Ebagoola 1:250k map sheet is approximately 50% complete. New regional ecosystems found in Torres Strait as part of a 1:25,000 scale external mapping project have been incorporated into the Cape York Peninsula bioregion RE framework. An extensive review and update of Einasleigh Uplands bioregion regional ecosystem mapping was completed. Work continues on detailed technical descriptions for the regional ecosystems of the Einasleigh Uplands and Cape York Peninsula bioregions.

In the Channel Country bioregion, Tickalara map sheet was completed. In the Gulf Plains bioregion, Donor's Hill map sheet is 85% complete. Work began on the Durham Downs map sheet.
Two major field trips were undertaken on the Donors Hill and the Tickalara mapsheets respectively. These resulted in 30 secondary sites 3000 quaternary sites and numerous specimens being collected.
Work continues on databasing the detailed secondary sites for the Einasleigh Uplands, Cape York Peninsula and Gulf Plains bioregions into Queensland's CORVEG database.

Ficus variegata, photo: Gary Wilson.

Professor Darren Crayn and Curator Frank Zich (left), in the Herbarium.

Theme 5 – Unlocking our Knowledge

Rain Forest Key

The "Australian Tropical Rain Forest Plants - Trees, Shrubs and Vines" (a.k.a. the Rain Forest Key, or RFK) is an interactive multiple-entry identification and information system, where the user decides which characters to choose based on the specimen in hand. 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. The latest version, published in 2003, includes 2154 species of trees, shrubs and vines of northern Australian rain forests. Further development will add modules for other plant life forms including orchids, herbs, ferns, parasites, saprophytes, palms and pandans – together adding c. 865 species. It is anticipated that the new identification system for all plant groups will be available on the web by end of 2010, as well as on DVD and other novel technologies.

Herb Module - Work on the herb module progressed significantly in 2008. The appointment of a research assistant, Mr Fanie Venter enabled completion of character coding and descriptions for all species. Images have been captured for about 120 taxa. These have yet to be manipulated and prepared for incorporation into the package.

Fern Module – A character list of 80-100 characters has been developed. Further rationalisation of the character list is taking place as features of different fern groups are incorporated. Character help notes have been drafted for most characters and basic illustrations for the frond features have been prepared. Slides and digital images are yet to be manipulated and prepared for publication. Coding is so far complete for c.100 species of fern and all 17 species of rainforest Lycopodiaceae. Coding is complete for the fern families Polypodiaceae, Blechnaceae, Athyriaceae, Cyatheaceae, Vittariaceae, Ophioglossaceae and Lindsaeaceae as well as a broad selection of genera from remaining families.

Research Team: Herbs – Fanie Venter (CSIRO, ATH), Frank Zich (ATH). Ferns - Ashley Field (ATH, JCU), Dr Jim Croft and John Connors (Aust. National Botanic Gardens), Peter Bostock (Queensland Herbarium)

"The Wet Tropics Bioregion contains about 25% of Australia's vascular plant species in about one quarter of one percent of the land area."

Participants in activities

Staff

Prof. Darren Crayn – Director, Research Scientist (systematics, evolutionary biology)

Mr Frank Zich – Curator, Research Scientist (systematics)

Ms Eda Addicott – Research Scientist and Team Leader (Regional Ecosystem mapping)

Ms Melissa Harrison – Laboratory Manager and Research Assistant

Ms Andrea Lim – Administration

Mr Mark Newton – Research Scientist (Regional Ecosystem mapping)

Mr Gary Wilson – Research Scientist (Regional Ecosystem mapping)

Mr Gerry Turpin – Research Scientist (systematics, ethnobotany, Regional Ecosystem mapping)

Mr Peter Bannink – GIS support (Regional Ecosystem mapping)

Prof. Paul Gadek – Research Scientist (systematics, evolutionary biology)

Ms Sandra Abell-Davis – Research Scientist (systematics, mycology)

Dr Jonathan Cornelius – Research Scientist (agroforestry)

Dr Tony Page – Research Scientist (agroforestry)

Ms Michelle Migdale – Administration (left Aug 08)

Research Students

Mr Craig Costion (PhD, University of Adelaide)

Ms Margaret Heslewood (PhD, University of Adelaide)

Ms Hannah McPherson (PhD, University of New England)

Volunteers

Mr Murray Borrell

Mrs Wendy Cooper

Ms Rachel Davison

Mrs Mary Gandini

Mr Bob Jago

Mrs Debra McKeown

Mrs Nada Sankowsky

Ms Natalie Wittmeier

Mr Stuart Worboys

Mr Guillaume Chomicki-Bayada

Mr Donn Corcoran

Mrs Nanette Fairbairn

Ms Sandra Holzhauser

Mrs Catherine Kaehne

Mr Garry Sankowsky

Mr Lincoln Thompson

Mrs Judith Woods

Visiting Researchers

Mr Peter Bostock (Queensland Herbarium)

Mr John Clarkson (Qld Dept. Primary Industries)

Mr John Connors (Australian National Herbarium)

Mr Peter Cooper (naturalist and local landowner)

Mr Ashley Field (JCU, CSIRO)

Mr Andrew Ford (CSIRO)

Prof. Ryuji Ishikawa (Hirosaki Univ., Japan)

Dr Surrey Jacobs (National Herbarium of NSW)

Dr Bill McDonald (Queensland Herbarium)

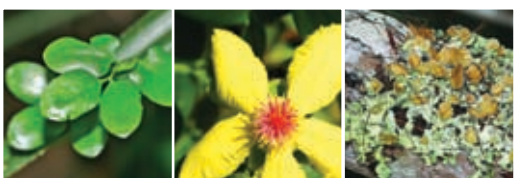
Dr Brett Murphy (Univ. Tasmania)

Prof. Takashi Osono (Kyoto University)

Mr Nick Smith (Ethnobotanist)

Mr Fanie Venter (CSIRO)

Dr Henk van der Werff (Missouri Botanical Garden)



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