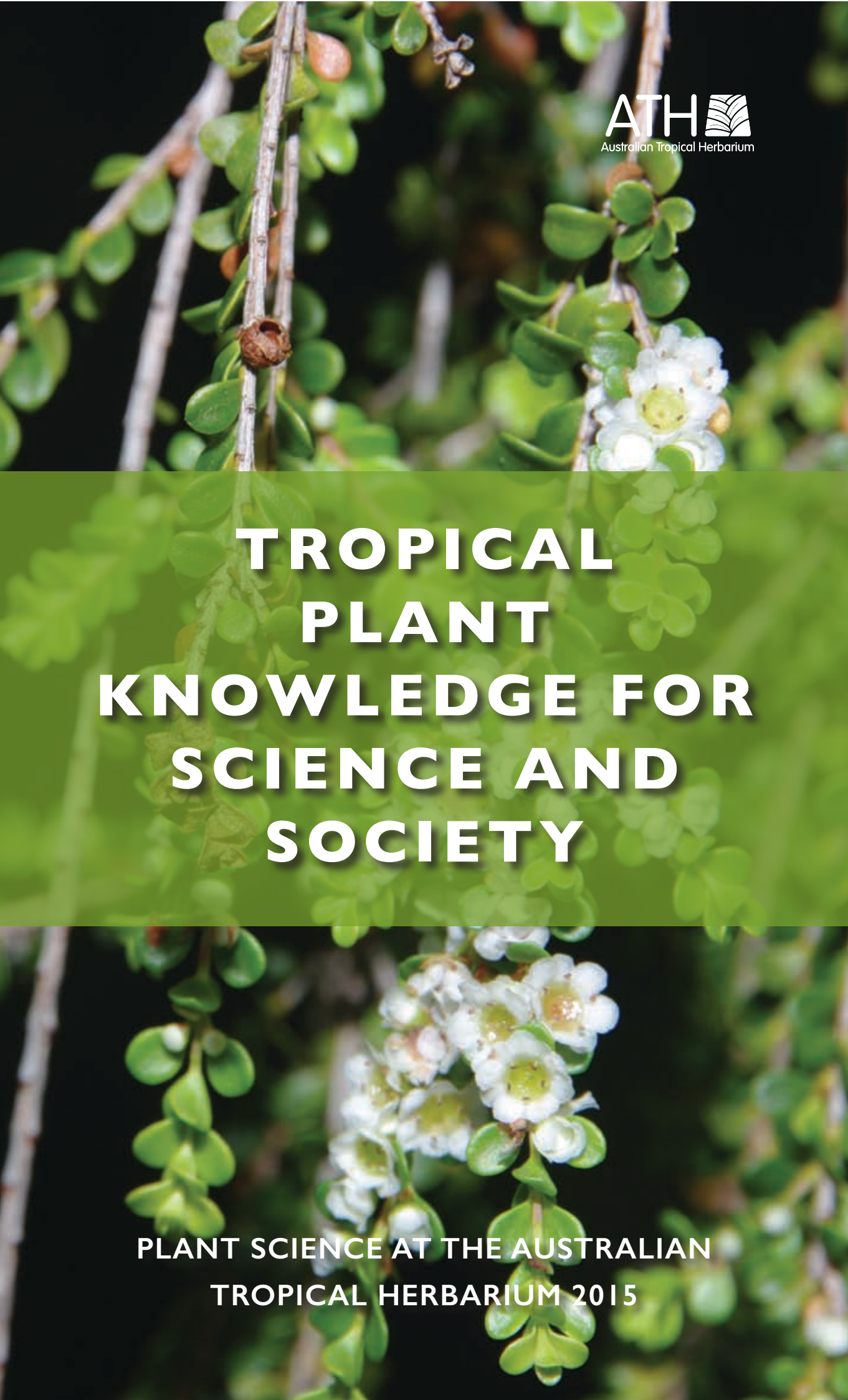


TROPICAL PLANT KNOWLEDGE FOR SCIENCE AND SOCIETY

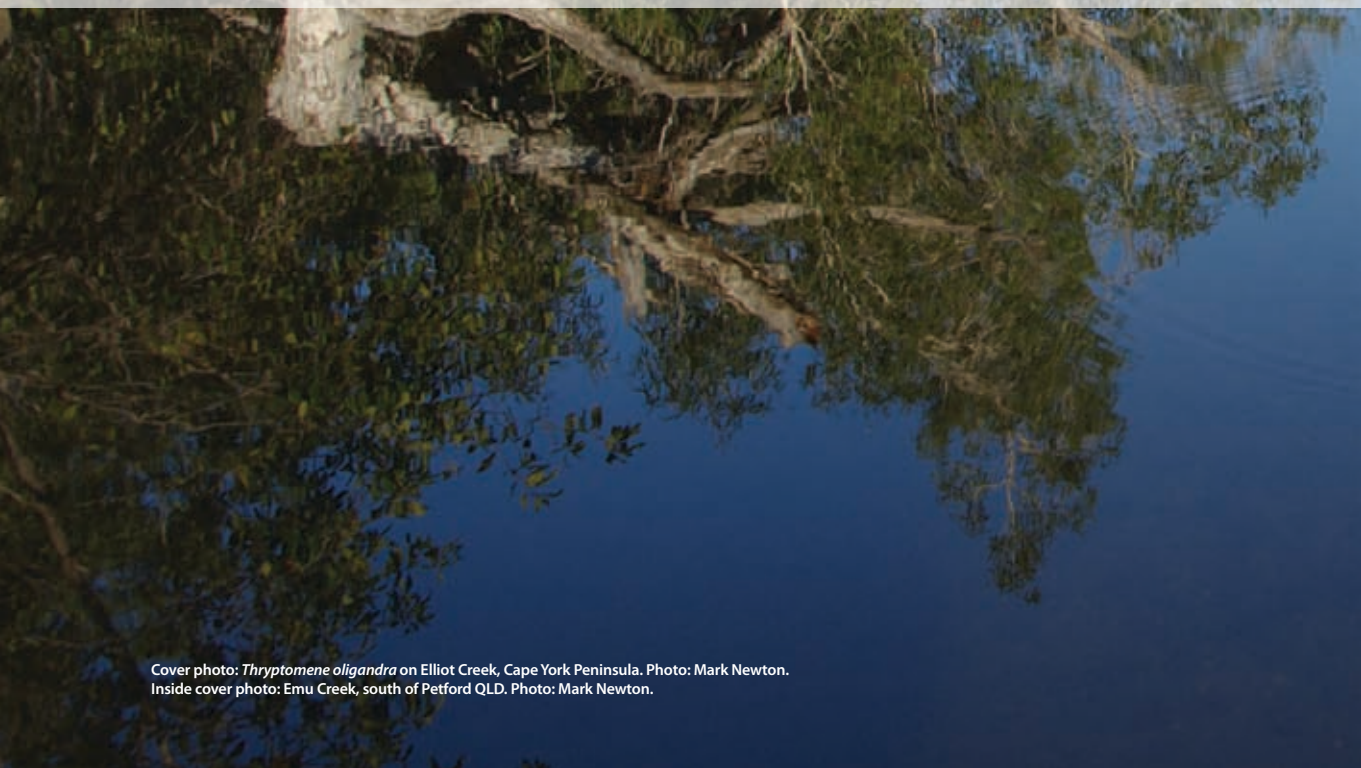
PLANT SCIENCE AT THE AUSTRALIAN TROPICAL HERBARIUM 2015

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 Science, Information Technology, and Innovation (DSITI), and James Cook University (JCU). The ATH is located on the Cairns campus of JCU, and administratively is part of JCU's Division of Tropical Environments and Societies.

The ATH's vision is to be a leader in tropical plant biodiversity research, that conducts diverse, relevant and innovative research; translates 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.

The ATH Board oversees the operations of the ATH and sets overall strategic management policy and objectives. The Board comprises two representatives of each of the joint venture participants, and an independent Chair.

We acknowledge Aboriginal and Torres Strait Islander People as the first inhabitants of the nation and acknowledge Traditional Owners of the lands where our staff, students, and associates live, learn and work.



Cover photo: *Thryptomene oligandra* on Elliot Creek, Cape York Peninsula. Photo: Mark Newton.
Inside cover photo: Emu Creek, south of Petford QLD. Photo: Mark Newton.

CONTENTS

ATH Board members and Director: Back row (l-r): Prof Darren Crayn (Director, ATH), Dr Gordon Guymer (Director, Queensland Herbarium, Queensland Department of Science, Information Technology and Innovation), Dr Greg Leach (Chair, ATH Board), Dr Christine Williams (Assistant Director General, Queensland Department of Science, Information Technology and Innovation). Front row (l-r): Dr Linda Broadhurst (Director, Australian National Herbarium, National Research Collections Australia, CSIRO), Prof Andrew Young (Director, National Research Collections Australia, CSIRO), Prof Iain Gordon (Deputy Vice Chancellor, Division of Tropical Environments and Societies, James Cook University), Prof Marcus Lane (Dean, College of Science and Engineering, James Cook University). Photo: Andrea Lim.

OUR HISTORY

Prior to the establishment of the ATH, plant biodiversity science research in Australia's tropical northeast was undertaken at three centres: the CSIRO Atherton Herbarium (QRS), the Mareeba Collection (MBA) of the Queensland Herbarium, and James Cook University (JCT). The retirement in 2002 of the Director of the Atherton Herbarium, the eminent botanist Dr Bernie Hyland, led to discussions between the CSIRO, James Cook University and the Queensland Government regarding a joint venture herbarium project. An agreement to establish the Australian Tropical Herbarium was signed on 30th of April 2006.

The Sir Robert Norman Building was completed on the Smithfield campus in November 2007, containing state-of-the-art facilities purpose-designed for the joint venture. The QRS and MBA collections were moved into the new premises soon thereafter. The Hon. Anna Bligh, Premier of Queensland opened the building on the 4th of March 2008 and the inaugural Director commenced duty on the 31st of March, the Operational Date of ATH.

During the seven year term of the first ATH Agreement, the organisation grew from nine staff (full time equivalents) and three postgraduate students to 15 staff and 18 postgraduate students, and increased its outputs, outcomes and impact many-fold. On April 1 2015 the Joint Venture partners agreed to a further 10-year term.

The Sir Robert Normal Building incorporating the Australian Tropical Herbarium. Photo: Brad Newton.

Representatives of the ATH Joint Venture partners celebrating the signing of the new agreement: (l-r) Dr Linda Broadhurst (CSIRO), Prof Jeff Loughran (JCU), Dr Christine Williams (Qld Govt). Photo: Dominic Chaplin.

SCIENTIFIC COLLECTIONS – FOUNDATIONAL INFRASTRUCTURE

Biodiversity science is enabled by research collections of expertly curated biological specimens. Such collections constitute an authoritative storehouse of information about biodiversity and underpin taxonomic, genetic, agricultural and ecological research - making these vital resources for conservation and the development of sustainable land and marine management systems.

The ATH boasts extensive research collections housed in facilities that are the state-of-the-art for preservation and research. The research herbarium comprises more than 180,000 pressed, dried plant specimens. The 'wet' collection of more than 14,000 samples preserves the soft parts of plants (e.g. fruits) in fluids for anatomical and other studies. A wood block collection enables research on the structural and functional properties of wood. Our DNA and tissue collection of over 19,000 samples representing over 5,000 species is the foundation of studies on genetics and evolutionary biology. Several thousands of specimens and samples are added each year to the ATH collections as a result of research activities.

HERITAGE COLLECTIONS

Among the ATH collections are items of immense scientific and cultural significance. These include three of the original botanical specimens collected in 1770 at the Endeavour River (now Cooktown) by Joseph Banks and Daniel Solander, botanists on Cook's first circumnavigation of the globe (1769-1772).

Other important items include over 18,200 collections (46,000 items) of B.P.M. (Bernie) Hyland, the eminent and pioneering botanist of Australia's northern rainforests, 9,300 collections (26,600 items) of Bruce Gray, and orchid specimens from the collection of Alec Dockrill.

An herbarium specimen held in the ATH collections. Photo: Frank Zich.

ATH research worker Raelee Kerrigan curating the herbarium collections. Photo: Andrea Lim.

DISCOVERIES MAKING A DIFFERENCE

KEEPING INDIGENOUS PLANT KNOWLEDGE ALIVE

Plants have been at the centre of Indigenous cultures for millennia, and Traditional Owners are custodians of profound knowledge of the properties and uses of plants. The Tropical Indigenous Ethnobotany Centre (TIEC) partnership, based at the ATH, works through mutually beneficial partnerships with Traditional Owners to research traditional use of plants. Knowledge flow is two-way: Traditional Owners are empowered to keep their knowledge strong and to participate in and benefit from new discoveries (see p. 19).

UNDERSTANDING PATHOGENS

Managing diseases in natural and managed environments such as farms and nurseries requires knowledge of the pathogens that cause them. Research by ATH scientists is helping improve the understanding of the factors involved in fungal diseases of myrtaceous plants such as eucalypts and myrtles, and insects. Research is also underway into fungi that can help control nematode diseases of bananas.

Sterculia shillinglawii, a north Queensland plant of Indigenous cultural significance. Photo: T. Collis.

Exemplar project - Mbabaram traditional plant use research. Project Leader – Gerry Turpin.

This collaborative project involving the Watsonville Aboriginal Corporation (Mbabaram) and the National Institute of Complementary Medicine (NICM, University of Western Sydney) is investigating the bioactive potential of medicinal plants of the Mbabaram people. TIEC, with assistance from Mbabaram Traditional Owners, collects and prepares plant materials used in traditional medicines for analysis by NICM under agreement. Subject to further funding, TIEC will work towards an agreement to commercialise any medicinal plants with potential.

Gerry Turpin, ATH Indigenous ethnobotanist examining culturally significant flora on Olkola country, Cape York Peninsula. Photo: Ben Menadue.

Exemplar project - Entomopathogenic fungi. Project Leader – Sandra Abell.

Fungi that infect insects are common in tropical regions. Despite their abundance, they have never been taxonomically studied in Australia. Recent collections from Australian rainforests have revealed a diversity (over 150) of unclassified taxa on ants, flies, scale insects and spiders. This project will focus on the genera *Akanthomyces, Cordyceps, Gibellula, Hirsutella, Hypocrella, Ophiocordyceps,* and *Torrubiella*. A systematic revision and Lucid guide to at least 40 Australian species will be produced. This project will contribute to a better understanding of the health of insect communities and the identity of potential biological control agents of insect pests.

DISCOVERING NEW SPECIES

Herbarium collections are the real frontiers of plant species discovery – most new species are discovered not by intrepid explorers in wild and remote places, but by scientists working painstakingly on existing, understudied collections. ATH scientists have named 42 new species of plants and fungi since 2008 including wild relatives of lilly-pillies, melons, mangosteens, heathers, quandongs and truffles, and are currently working on many more. The potential utility of plants and fungi to humans (for fibre, fuel, food, medicine or amenity), their role in the environment, and their conservation can only be addressed once they have been discovered and accurately classified.

Fruit and fallen leaves of the rainforest tree *Elaeocarpus grandis*. Photo: Andrea Lim.

A species of *Ophiocordyceps* fungi new to science fruiting from the carcass of its ant prey. Photo: Sandra Abell.

Exemplar project - Phylogenetics, systematics and evolutionary dynamics of Elaeocarpaceae. Project Leader – Darren Crayn.

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. New species are described as they are found.

MAPPING AND MEASURING OUR BIODIVERSITY HERITAGE

Land use decision-making such as conservation reserve selection and management is based upon assessments of vegetation type and condition, threat, rarity and importance. We are contributing substantially to the evidence base for such decisions in northern Australia through mapping of Regional Ecosystems as well as identification of hotspots of biodiversity. For the latter we are applying novel assessment methods that incorporate measures of evolutionary distinctiveness, which enables better management for a range of predicted, and unforseen, environmental futures.

Exemplar project - Regional Ecosystem Mapping. Project Leader – Eda Addicott.

The Queensland Herbarium's Regional Ecosystems (RE) Mapping Program is an extensive survey, mapping and monitoring program of the State. The RE maps, which show pre-clearing, remnant vegetation and regional ecosystems, are important tools for government, landholders and scientists to plan and manage the natural environment, developments and vegetation restoration. As part of the RE mapping program, ATH staff are mapping (at 1:100,000 scale) the Cape York Peninsula (CYP) and Einasleigh Uplands (EIU) bioregions and updating the Wet Tropics (WET) bioregion mapping at 1:50,000 scale. Mapping and survey is done in blocks of 1:250,000 scale map sheets.

ATH staff Eda Addicott surveying vegetation on Cape York Peninsula. Photo: Mark Newton.

PROVIDING USEFUL TOOLS FOR THE COMMUNITY

A vast amount of information on the ecology, biology, uses and conservation status, of Australia's native plants has been compiled through over 240 years of scientific endeavour. This wealth of data can greatly improve our ability to sustainably manage our biodiversity. While publicly and freely available through the Atlas of Living Australia (ala.org.au), it can only be utilised if the species name is accurately known. Knowledge for identifying plants can be very difficult to access by non-specialists: highly technical, expensive and held in distant libraries. The development and deployment of web-based interactive identification systems and apps targeted at the non-specialist enables almost anybody, anywhere to identify and learn about Australia's flora. This helps all community sectors to achieve their land and environmental assessment, management, educational, scientific and recreational goals. Principal beneficiaries include the resources, agricultural and horticultural industries, Indigenous land managers, private and public conservation estate managers, students, tourists, and scientific researchers.

Exemplar project – Australian Tropical Rainforest Plants Identification System. Project Leader – Frank Zich.

The Australian Tropical Rainforest Plants identification system (www.anbg.gov.au/cpbr/cd-keys/rfk/) is an easy to use, free, online system that enables almost anybody, anywhere to identify nearly 3000 species of tropical rainforest plants in Australia. The uptake by the user community has been overwhelming – over 15,000 visits per month. The ATH continues to develop this system including extending its taxonomic and geographical coverage, and is working to initiate an even more exciting project: the Australian Savanna Plant Identification System (see p. 19).

PREDICTING BIODIVERSITY IMPACTS OF ENVIRONMENTAL CHANGE

The one thing that is constant in the environment is change. Predicting the impacts that environmental change will have on biodiversity is critical to ensuring we manage for its survival and adaptation. We are driving several modelling projects that are determining the nature and extent of climate change threats to the plant species of tropical mountains in Australia and South America, many of which are found nowhere else on Earth.

Exemplar project – Orchid distributional modeling. Project Leaders – Lalita Simpson and Katharina Schulte.

Herbarium collections provide important information about plant distributions and therefore about the environmental requirements (niches) of species. By combining species distribution modeling and molecular phylogenetic evidence we are discovering how past climatic changes drove the evolution of the orchids of the Australian Wet Tropics. Using models of future climatic conditions, we are able to predict the impact of climate change on orchid species, in particular the rare and endemic orchid species of Australia's tropical mountain tops.

Bulbophyllum gadgarrense (Oxysepala gadgarrensis), an epiphytic orchid endemic to northeast Queensland rainforests. Photo: Andrea Lim.

Front page of the online Australian Tropical Rainforest Plants identification system. Photo: Darren Crayn.

UNDERSTANDING WILD RELATIVES OF DOMESTICATED PLANTS

Modern agriculture is re-discovering the potential of wild relatives of crop species as sources of traits for disease resistance, drought and salt tolerance, and nutritive value. Northern Australia has unique wild relatives of many important crops including rice, banana, cotton, melon, coffee, mangosteen, macadamia and sandalwood. ATH researchers are contributing to collaborative research programs on wild crop relatives that aim to improve food security in the tropics worldwide.

PIECING TOGETHER THE ORIGINS AND EVOLUTION OF THE FLORA

From where did our flora come? How has it evolved? How will it adapt to environmental change? ATH researchers are using genetic analysis to peer into the past and discover the origins of some of our most unique flora such as orchids, fungi, ferns, and quandongs. Piecing together the evolutionary pathways of lineages from their deep time origins to the modern day species enables a better understanding of not only how organisms evolve, but how and why ecosystems change through time. This knowledge is essential to predict how species might adapt in a changing world.

Garcinia warrenii, one of six native Australian species of the mangosteen genus. Photo: Gary Wilson.

Exemplar project – The origins of mangosteen. Project Leaders – Rismita Sari and Paul Gadek.

The mangosteen – *Garcinia mangostana* – is highly prized for its sweet, juicy flesh. Native to Indonesia, it is at least 250 species of *Garcinia* worldwide, although the number is highly disputed. Australia has at least nine native Garcinia species, several of these only described scientifically in the last few years. This project aims to shed light on the origins of the mangosteen by using genetics to discover which species it is most closely related to. The knowledge gained will assist with crop improvement programs which seek to increase production, fruit shelf life and disease resistance.

Exemplar project – The Malesian floristic interchange. Project Leader – Darren Crayn.

The origins of Australia's unique flora has fascinated scientists since the first specimens were brought to Europe in the 17th century. While much of Australia's flora traces its ancestry to the ancient supercontinent of Gondwana of which it was once a part, continental drift over the last 40 million years has brought it into Asia and opened a highway for plant exchange between the northern and southern hemispheres. Research at the ATH is piecing together the details of this exchange and discovering which lineages are 'newcomers' to Australia and the circumstances under which they came.

BUILDING USEFUL CLASSIFICATIONS

Biological classifications, or taxonomies, are systems for ordering knowledge of the relationships among organisms and governing the scientific naming of them. Classifications and names are the way we communicate about organisms both in science and in daily life, and like a well-organised library, an accurate classification improves efficiency and quality in research and communication. ATH scientists are using their discoveries to refine plant classifications, ensuring that they reflect the most accurate and up-to-date knowledge.

Exemplar project – Taxonomy of orchids. Project Leader – Katharina Schulte.

Australia harbours a rich and highly endemic orchid flora. Based on DNA sequence data we are resolving evolutionary relationships for Australasian orchids. The molecular phylogenetic trees provide the scientific basis for re-examining controversial taxonomic concepts in order to improve our classification system. Orchid groups studied cover a broad range of Australian orchids, such as from the mega genus *Dendrobium*, or the highly diverse orchid tribe Diurideae which harbours the majority of Australian orchid species, with many threatened species. Phylogenetic evidence is used to improve orchid classifications at higher taxonomic level (e.g. at genus level) as well as to assess species delimitation questions.

Flowers of *Barringtonia calyptrata*, a lowland rainforest tree of northern Australia and New Guinea. Photo: T. Collis.

A ground orchid, *Thelymitra atronitida*. Photo: Lars Nauheimer.

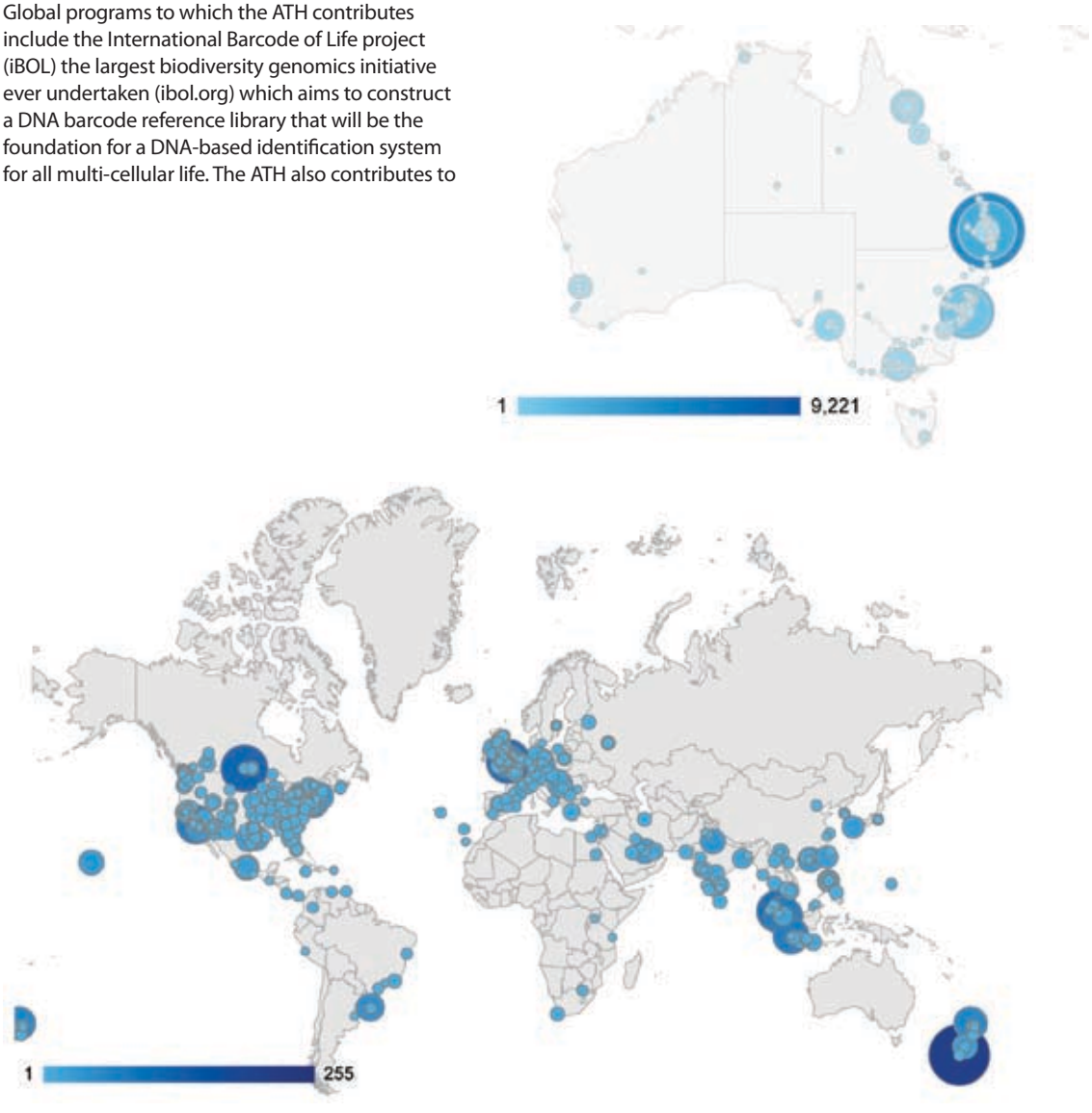
SCIENCE DELIVERY–LOCAL TO GLOBAL

Science at the Australian Tropical Herbarium is focused on northern Australia. Through programs such as the Regional Ecosystem mapping of the Cape York, Einasleigh Uplands and Wet Tropics Bioregions, the Tropical Indigenous Ethnobotany Centre research on traditional plant use by north Queensland Indigenous peoples, and the studies of the origins, evolution and conservation of Australia's tropical flora we are improving knowledge of plants in the Australian tropics.

Beyond Australia, ATH staff and students work with researchers around the world on problems of local to global relevance. Our research is undertaken with colleagues on almost all continents including Argentina, Brazil, China, Estonia, Federated States of Micronesia, Germany, Indonesia, Japan, Malaysia, New Zealand, Papua New Guinea, Singapore, Solomon Islands, UK, USA and Vanuatu. Institutional relationships through organisations such as the Council of Heads of Australasian Herbaria provide further collaborative partnerships.

Global programs to which the ATH contributes include the International Barcode of Life project (iBOL) the largest biodiversity genomics initiative ever undertaken (ibol.org) which aims to construct a DNA barcode reference library that will be the foundation for a DNA-based identification system for all multi-cellular life. The ATH also contributes to Global Plants, the world's largest community-contributed database used by students and researchers worldwide (plants.jstor.org). Through Global Plants, herbaria share high quality images of their plant Type specimens, experts determine and update plant names, and students discover and learn about plants in context, supporting research and teaching in botany, ecology and conservation.

ATH research has global impact: our scientific publications have been cited thousands of times by researchers all over the world, and the Australian Tropical Rainforest Plants online identification system website receives around 15,000 hits per month, many from outside of Australia.



Maps showing the national (top) and global usage of one ATH product, the Australian Tropical Rainforest Plants online identification system.

ATH botanist Stuart Worboys delivering plant identification training in the classroom.

ATH STAFF SHARE THEIR BOTANICAL EXPERTISE IN MANY WAYS

Stuart Worboys delivering plant identification training in the field.

SHARING OUR KNOWLEDGE

COMMUNITY ENGAGEMENT, SERVICE, AND REPRESENTATIVE ROLES

ATH staff share their botanical expertise in many ways. We regularly give community talks and lectures on our research and other topics of current interest in Australia and overseas, we teach University plant science as well as giving talks to primary and secondary school groups and TAFE classes, and we host herbarium tours and talks for a broad range of stakeholder groups.

Through the Rainforest Plant Identification Courses we deliver, in partnership with the Wet Tropics Management Authority, modular workshop-style tuition in the skills and resources needed to identify both native and weedy plant species in the rainforests of the Wet Tropics. The many past participants include environmental professionals, rangers, students and interested public.

ATH staff have delivered many other workshops to community and professional groups on diverse topics such as plant pathogens, fire in the landscape, techniques for documenting cultural plant use, and plant classification.

We also provide a plant identification service which supports professionals in the commercial and not-for-profit sectors, as well as members of the public and students. We maintain a Public Reference Collection of authoritatively identified plant specimens that is free to use, and allows students, consultants and others identify and learn about north Queensland plants.

ATH staff share their expertise in many other ways, including through roles on various Councils, Advisory and Scientific Committees and Reference Groups for Commonwealth, State and Local Governments and not-for-profit groups and societies, numbering 14 such roles in 2015.

The ATH public reference collection.

Bulbophyllum lilianiae. Photo: Lalita Simpson.

2,300 SAMPLES ACCESSIONED INTO THE DNA AND TISSUE BANK, WHICH NOW CONTAINS OVER 19,000 SAMPLES

ATH wood block collection. Photo: Andrea Lim.

SUMMARY OF ACHIEVEMENTS 2015

SCIENCE DELIVERY – LOCAL TO GLOBAL

Our science was communicated broadly through

- 34 peer-reviewed publications (most in international journals)
- 7 reports and general articles
- 21 research seminars at international conferences and local meetings
- 9 public talks to mostly local groups.

This science was supported in part by

- $204,126 external research grant income
- collaborations with 71 scientists in 8 countries.

SHARING OUR KNOWLEDGE

ATH staff shared our knowledge through:

- training and knowledge sharing workshops delivered to nine Indigenous groups in north Queensland and the Kwaio community, Malaita, Solomon Islands;
- plant identification training delivered through four workshops to the public and to government and industry stakeholders;
- responding to 176 scientific enquiries and completing 938 plant identifications for external stakeholders;
- hosting 392 public visitors participating in school, public and professional group tours;
- hosting 34 scientists undertaking research at the ATH;
- 14 representative and leadership roles on international, national, and local bodies.
- communicating through 58 media items including 3 television, 13 radio, 30 print and 12 online media articles.

BUILDING, IMPROVING AND MOBILISING OUR COLLECTIONS

- 1,197 herbarium specimens accessioned into CNS, 3,474 collection records edited and 2,048 specimens re-determined.
- 2,300 samples accessioned into the DNA and Tissue Bank, which now contains over 19,000 samples
- 27,156,858 records downloaded in 55,474 download events by a range of external user groups through the Atlas of Living Australia portal (ala.org.au)
- 2076 images of 734 TYPE specimens made available through JSTOR as part of the Global Plants project (plants.jstor.org).

The ATH thanks its many wonderful volunteers for their valuable contributions to our specimen processing, field and research programs.

PUBLICATIONS

WEB RESOURCES

Pert PL, Ens EJ, Locke J, Clarke PA, Packer JM, Turpin G (2015). Australian Indigenous Biocultural Knowledge ACEAS Working Group website www.aibk.info (Winner, 2014 Banksia Award for Indigenous Leadership in Sustainability)

BOOK CHAPTERS

Venter F, Arihafa A (2015) Vascular plants. In 'A Rapid Biodiversity Assessment of Papua New Guinea's Hindenberg Wall Region.' (Eds S Richards, N Whitmore.) pp 14-43. (Wildlife Conservation Society: Goroka, Papua New Guinea)

Venter F, Arihafa A (2015) Plants of Mussau Island. In 'A Rapid Biodiversity Survey of Papua New Guinea's Manus and Mussau Islands.' (Ed. N Whitmore) (Wildlife Conservation Society Papua New Guinea Program: Goroka, Papua New Guinea)

SCIENTIFIC PAPERS

Apgaua DMG, Pereira DGS, Santos RM, Menino GCO, Pires GG, Fontes MAL, Tng DYP (2015) Floristic variation within seasonally dry tropical forests of the Caatinga Biogeographic Domain, Brazil, and its conservation implications. *International Forestry Review* 17 (S2), 33-44.

Bransgrove K, Middleton DJ (2015) A revision of *Epithema* (Gesneriaceae). *Gardens Bulletin Singapore* 67, 159-229.

Clarke C, Moran JA (2015) Climate, soils and vicariance - their roles in shaping the diversity and distribution of *Nepenthes* in Southeast Asia. Plant and Soil 1-15.

Cooper T, Furtado A, Henry RJ, Crayn D (2015) Analysis of the chloroplast genome of a coffee relative from northern Australia. *Acta Horticulture* 1101, 177-182.

Cooper WE (2015) A taxonomic revision of *Cynometra* L. (Fabaceae) in Australia with a new species from the Wet Tropics of Queensland and a range extension to the mainland. *Austrobaileya* 9, 393-403.

Costion C, Edwards W, Ford A, Metcalfe DJ, Cross H, Harrington M, Richardson JE, Hilbert DW, Lowe A, Crayn D (2015a) Using phylogenetic diversity to identify ancient rain forest refugia and diversification zones in a biodiversity hotspot. *Diversity and Distributions* 21, 279-289.

Costion CM, Simpson L, Pert P, Crayn DM (2015b) Will tropical mountaintop plant species survive climate change? Identifying key knowledge gaps using species distribution modelling in Australia. *Biological Conservation* 191, 322-330.

Cowie ID, Kerrigan RA (2015) A new species of *Cochlospermum* (Bixaceae) from Arnhem Land, Northern Territory, Australia. *Telopea* 18, 135–140.

Crayn DM, Costion C, Harrington MG (2015a) The Sahul–Sunda floristic exchange: dated molecular phylogenies document Cenozoic intercontinental dispersal dynamics. *Journal of Biogeography* 42, 11-24.

Crayn DM, Winter K, Schulte K, Smith JAC (2015b) Photosynthetic pathways in Bromeliaceae: the phylogenetic and ecological significance of CAM and C3 based on carbon-isotope ratios for 1875 species. *Botanical Journal of the Linnean Society* 178, 169-221.

de Boer HJ, Steffen K, Cooper WE (2015) Sunda to Sahul dispersals in *Trichosanthes* (Cucurbitaceae): a dated phylogeny reveals five independent dispersal events to Australasia. *Journal of Biogeography* 42, 519-531.

Dowe JL (2015a) "I saw a good deal of the country much more than any other collector": An assessment of the botanical collections of Eugene Fitzalan (1830–1911). *Cunninghamia* 15, 87-133.

Dowe JL (2015b) Overlooked plant species names associated with the botanical collections of Eugene Fitzalan. *Austrobaileya* 9, 439-444.

Ens EJ, Pert P, Clarke PA, Budden M, Clubb L, Doran B, Douras C, Gaikwad J, Gott B, Leonard S, Locke J, Packer J, Turpin G, Wason S (2015) Indigenous biocultural knowledge in ecosystem science and management: Review and insight from Australia. *Biological Conservation* 181, 133-149.

Field AR, Testo W, Bostock PD, Holtum JAM, Waycott M (2015) Molecular phylogenetics and the morphology of Lycopodiaceae subfamily Huperzioideae support three genera: *Huperzia, Phlegmariurus and Phylloglossum. Molecular Phylogenetics and Evolution* 94, 635-657.

González-Orozco CE, Mishler BD, Miller JT, Laffan SW, Knerr N, Unmack P, Georges A, Thornhill AH, Rosauer DF, Gruber B (2015) Assessing biodiversity and endemism using phylogenetic methods across multiple taxonomic groups. *Ecology and Evolution* 5(22), 5177-5192.

Gray B (2015) Three new species of *Taeniophyllum* Blume (Orchidaceae) from northern Queensland. *Austrobaileya* 9, 382-392.

Heller S, Leme EMC, Schulte K, Benko-Iseppon AM, Zizka G (2015) Elucidating phylogenetic relationships in the *Aechmea* alliance: AFLP Analysis of P*ortea* and the *Gravisia* complex (Bromeliaceae, Bromelioideae). *Systematic Botany* 40, 716-725.

Holzmeyer L, Duretto M, Crayn D, Hörandl E, Heslewood M, Jayanthan J, Appelhans MS (2015) Phylogeny of Acronychia (Rutaceae) and first insights into its historical biogeography and the evolution of fruit characters. *PloS One* 10 (8), e0136296. doi:10.1371/journal.pone.0136296.

Hughes M, Barber S, Heatubun CD, Gagul J (2015) *Begonia yapensis* (sect. Symbegonia, Begoniaceae), a new species from Papua, Indonesia. *European Journal of Taxonomy* 119, 1-6.

Laity T, Laffan SW, González-Orozco CE, Faith DP, Rosauer DF, Byrne M, Miller JT, Crayn D, Costion C, Moritz CC, Newport K (2015) Phylodiversity to inform conservation policy: An Australian example. *Science of the Total Environment* 534, 131-143.

Nagalingum NS, Knerr N, Laffan S, González-Orozco CE, Thornhill A, Miller JT, Mishler BD (2015) Continental scale patterns and predictors of fern richness and phylogenetic diversity. *Frontiers in Genetics* 6, 132.

Pert PL, Ens EJ, Locke J, Clarke PA, Packer JM, Turpin G (2015) An online spatial database of Australian Indigenous Biocultural Knowledge for contemporary natural and cultural resource management. *Science of the Total Environment* 534, 110-121.

Pineiro R, Micheneau C, Dauby G, Hardy O (2015) Isolation, characterization and cross-species amplification of nuclear microsatellites in the African tree genus *Greenwayodendron* (Annonaceae). *Journal of Tropical Forest Science* 28(2).

Pollock LJ, Rosauer D, Thornhill AH, Kujala H, Crisp MD, Miller JT, McCarthy MA (2015) Phylogenetic diversity meets conservation policy: small areas are key to preserving eucalypt lineages. *Philosophical Transactions of the Linnean Society, Series B 370*, 20140007.

Quinn CJ, Crowden RK, Brown EA, Southam MJ, Thornhill AH, Crayn DM (2015) A reappraisal of the generic concepts of *Epacris, Rupicola and Budawangia* (Ericaceae, Epacridoideae, Epacrideae) based on phylogenetic analysis of morphological and molecular data. *Australian Systematic Botany* 28, 63-77.

Thornhill AH, Ho SYW, Külheim C, Crisp MD (2015) Interpreting the modern distribution of Myrtaceae using a dated molecular phylogeny. *Molecular Phylogenetics and Evolution* 93, 29-43.

Trapnell DW, Beasley RR, Lance SL, Field AR, Jones KL (2015) Characterization of microsatellite loci for an Australian epiphytic orchid, *Dendrobium calamiforme,* using Illumina sequencing. *Applications in Plant Sciences* 1500016.

Tree DJ, Mound LA, Field AR (2015) Host specificity studies on Gynaikothrips (Thysanoptera: Phlaeothripidae) associated with leaf galls of cultivated *Ficus* (Rosales: Moraceae) trees. *Florida Entomologist* 98, 880-883.

van der Ent A, Sumail S, Clarke C (2015) Habitat differentiation of obligate ultramafic *Nepenthes* endemic to Mount Kinabalu and Mount Tambuyukon (Sabah, Malaysia). *Plant Ecology* 216, 789-807.

Zhang L, Rothfels CJ, Ebihara A, Schuettpelz E, Le Péchon T, Kamau P, He H, Zhou X-M, Prado J, Field A, Yatskievych G, Gao X-F, Zhang L-B (2015) A global plastid phylogeny of the brake fern genus *Pteris* (Pteridaceae) and related genera in the Pteridoideae. *Cladistics* 31, 406-423.

GENERAL PUBLICATIONS AND REPORTS (UNREFEREED)

Schulte K (2015a) The ASBS conference workshop on the white paper on plant systematics and taxonomy in Australasia. *Australian Systematic Botany Society Newsletter* 162-163: 23-24.

Schulte K (2015b) From a White paper in Australasian Plant Systematics and Taxonomy to a Decadal plan – an update. *Australian Systematic Botany Society Newsletter* 161: 5-6.

Schulte K, Crayn D, Clements M (2015) Re-evaluation of current taxonomic concepts in Australian Orchidaceae utilizing phylogenies based on DNA barcodes and highly informative nuclear markers. Final report to ABRS, July 2015.

Neale V (2015) A multi-locus molecular phylogeny of the Diurideae (Orchidaceae), focusing on the evolution and diversification of subtribe Drakaeinae. CSIRO vacation scholarship 2014/2015, final report.

Newton MR, Addicott EP, Bannink P (2015) Survey and of Vegetation and Changes (2008-2013) of the East Trinity Reclamation Site.

Worboys S, Crayn D, Jobson R, Sankowsky G, Sankowsky N (2015) Olkola Bush Blitz. Survey of Vascular Plant, Olkola Lands, Southern Cape York Peninsula, 12-24 July 2015. Report to Bush Blitz, November 2015.

Anonymous (2015) State of the Wet Tropics Report 2014/15 – Ancient, threatened and endemic plants of the Wet Tropics World Heritage Area. Prepared under contract by Worboys S, Crayn D, Metcalfe D, Ford A.

THESES

Phoon S-N (2015) Systematics and biogeography of *Elaeocarpus* (Elaeocarpaceae) PhD, James Cook University. Supervised by Prof Darren Crayn and Prof Paul Gadek.

RESEARCH PRESENTATIONS

Addicott EP (2015a). Splitters and lumpers….towards consensus?, QLD Herbarium, Brisbane [oral].

Addicott EP (2015b). Classifying regional ecosystems in Queensland: incorporating statistical approaches. ATH Science Circle, Cairns [oral].

Cruz G, Silvestro D, Leme E, Zizka G, Schulte K, Campos J, Viccini A, Benko-Iseppon A (2015) Molecular infrageneric relationships and genome size evolution in *Cryptanthus*. 1st World Congress on Bromeliaceae Evolution, Recife, Brazil [oral].

Field A, Testo W, Bostock PD, Holtum JAM, Waycott M, Thornhill A (2015a) Molecular and morphological systematics of the Lycopodiaceae subfamily Huperzioideae: a case for the genera *Huperzia*, *Phlegmariurus* and *Phylloglossum*. Next Generation Pteridology, Smithsonian Botanical Symposium, Washington DC, USA [oral].

Gagul J, Crayn D, Nauheimer L (2015) Molecular phylogenetics of *Elaeocarpus* L. (Elaeocarpaceae) with a focus on New Guinea species. Australasian Systematic Botany Society conference, Canberra [oral].

Goetze M, Schulte K Palma-Silva C, Zanella CM, Büttow MV, Capra F, Bered F (2015) Diversification of Bromelioideae in the Atlantic rainforest: a case study in *Aechmea* subgenus *Ortgiesia*. 1st World Congress on Bromeliaceae Evolution, Recife, Brazil [poster].

Nauheimer L, Schley R, Crayn D, Clements M, Schulte K (2015) Unraveling complex evolutionary relationships in the Sun orchids (*Thelymitra*, Orchidaceae). Next-generation species delimitation conference, Canberra. 28 - 30 April 2015 [poster].

Neale V (2015) Diversification and evolution of the Hammer orchid alliance (Drakaeinae): a molecular study. ATH Science Circle, James Cook University, Cairns [oral].

Puente-Lelievre C, Hislop M, Potter B, Thornhill A, Freyman W, Kron K, Crayn D (2015) A detailed phylogenetic classification of Ericaceae: are we there yet? Australasian Systematic Botany Society conference, Canberra [oral].

Sari R, Gadek P, Davis SA, Apriliyanti P (2015). Ovoid mangosteen (*Garcinia mangostana* L.) from North Kalimantan. 5th International Conference on Plant Diversity. Jenderal Soedirman University, Purwokerto, Central Java, Indonesia [oral].

Schley R, Clements M, Micheneau C, Barraclough T, Crayn D, Schulte K (2015) Molecular phylogenetic insights into the diversification of the Sun orchids (*Thelymitra*, Orchidaceae). Systematics Association Biennial, Oxford, UK [poster].

Schulte, K (2015) Patterns of Australasian orchid diversification in space and time. Centre for Tropical Environmental and Sustainability Science – Annual Science Meeting, JCU, Cairns [oral].

Schulte K, Micheneau C, Field A, Weston P, Crayn D, Clements M (2015) The D*endrobium* alliance revisited: examining macroevolutionary patterns in Dendrobiinae (Orchidaceae). Australasian Systematic Botany Society conference, Canberra [oral].

Simpson L, Clements M, Crayn D, Costion C, Pert P, Carlsen M, Kress J, Schulte K (2015) Endemism in mountain top plant communities of Australia's Wet Tropics: Past, present and future. Australasian Systematic Botany Conference, Canberra [oral].

Thiele K, Barker WR, Crayn M, Waycott M, Holland A, Breitwieser I, Lockhart P, Bayly M, Weston PH, Schulte K (2015) Progress towards a Decadal Plan for Australasian Biodiversity Science – an update. Australasian Systematic Botany Conference, Canberra [oral].

Thornhill A, Miller JT, Knerr N, González-Orozco C, Laffan S, Costion C, Crayn D, Mishler B (2015) Spatial phylogenetics: determining patterns of diversity and endemism at different scales using examples from the Australian flora. VIII Southern Connections Congress, Punta Arenas, Chile.

Thornhill A, Ho S, Külheim C, Crisp MD (2015) Interpreting the biogeographic history of Myrtaceae using a fossil-calibrated dated molecular phylogeny. Botanical Society of America – Science and Plants for People, Edmonton, Canada.

Thornhill A, Knerr N, González-Orozco C, Laffan S, Mishler B, Miller JT (2015) Patterns of diversity and endemism at different phylogenetic scales using examples from the Australian flora. Botanical Society of America – Science and Plants for People, Edmonton, Canada.

Tran HTM, Cooper T, Furtado A, Crayn D, Henry R, Hamon P (2015) Whole chloroplast genome sequence of coffee species reveals their relationships. PAG Asia, Singapore [poster].

Turpin G (2015) Indigenous Symposium – convenor. Ecological Society of Australia conference, Adelaide [oral].

Zich F, Kerrigan R, Field A, Crayn D (2015). Ongoing development of the 'Australian Tropical Rainforest Plants' Interactive Identification Tool. Australasian Systematic Botany Society Conference, Canberra [oral].

COMMUNITY TALKS AND LECTURES

Crayn DM (2015) In search of plants: How Joseph Banks and the botany of Cook's first voyage changed the world. Friends of the Cairns Botanic Gardens, Walk and Talk series, Cairns.

Crayn DM (2015) Phylogenetics: A primer. Guest lecture BZ3620/5620 (Tropical Flora of Australia, Level 3).

Crayn DM (2015) Species concepts. Guest lecture BZ3620/5620 (Tropical Flora of Australia, Level 3).

Field AR, Zich F, Crayn DM (2015b) Beta testing of the Fern Module of the Australian Tropical Rainforest Plants identification key. Fern Study Group, Atherton Tablelands, Tolga.

Field AR (2015) Australian butterfly and host plant co-evolution: a whole biota phylogenetic perspective. Guest lecture BZ3620/5620 (Tropical Flora of Australia, Level 3).

Nauheimer L (2015) What questions can phylogenetics answer? Guest lecture BZ3620/5620 (Tropical Flora of Australia, Level 3).

Nauheimer L (2015) Climate change: insights from the past. Guest lecture BZ3755/5755 (Biodiversity and Climate Change, Level 3).

Nauheimer L (2015) Biodiversity and climate change in the wet tropics. Guest lecture BZ3755/5755 (Biodiversity and Climate Change, Level 3).

Turpin G (2015) The Tropical Indigenous Ethnobotany Centre. Land and Sea Rangers Conference, Cairns.

PARTICIPANTS IN ACTIVITIES 2015

STAFF

Dr Sandra Abell (JCU[1])

Ms Eda Addicott (DSITI)

Mr Peter Bannink (DSITI)

Ms Kaylene Bransgrove (JCU[2])

Prof Darren Crayn (CSIRO/JCU/DSITI)

Dr Ashley Field (DSITI)

Prof Paul Gadek (JCU[1])

Ms Melissa Harrison (JCU[2])

Ms Raelee Kerrigan (external grant)

Ms Andrea Lim (JCU)

Ms Sarah Mannel (external grant)

Dr Lars Nauheimer (external grant)

Mr Mark Newton (DSITI)

Dr Katharina Schulte (CSIRO/JCU)

Mr Gerry Turpin (DSITI)

Mr Stuart Worboys (JCU/ATH/external grant)

Mr Frank Zich (CSIRO)

[1] together contribute 1FTE research position

[2] together contribute 1FTE Laboratory Manager position

RESEARCH STUDENTS

Ms Eda Addicott (JCU)

Ms Agustina Arobaya (JCU)

Mr Habat Asad (JCU)

Ms Kaylene Bransgrove (JCU)

Ms Janet Gagul (JCU)

Ms Marcia Goetze (Universidade Sao Paolo, Brazil)

Ms Melinda Greenfield (JCU)

Ms Margaret Heslewood (University of Adelaide)

Ms Susan Nuske (JCU)

Ms Claudia Paz (JCU)

Ms Sook-Ngoh Phoon (JCU)

Ms Rismita Sari (JCU)

Ms Lalita Simpson (JCU)

RESEARCH ASSOCIATES

Dr Charles Clarke

Dr Wendy Cooper

Dr Craig Costion

Dr John Dowe

Mr Andrew Ford

Mr Bruce Gray

Dr Chris Quinn

Dr Andrew Thornhill

Prof Dorset Trapnell

Dr Fanie Venter

VOLUNTEERS

Ms Deborah Apgaua

Ms Marie Baade

Dr Charles Clarke

Mr Roger Fryer

Mrs Mary Gandini

Dr Chris Quinn

Ms Vivien Richardson

Ms Heather Winsor

Ms Vanessa Neale

Ethnobotanist Gerry Turpin.

AUSTRALIAN SAVANNAS ARE GLOBALLY RENOWNED FOR THEIR BIODIVERSITY AND ARE AMONG THE MOST INTACT ON EARTH

Brachychiton, a charismatic savanna plant. Photo: Ian Cowie.

AUSTRALIAN TROPICAL HERBARIUM – THE FUTURE

The ATH joint venture agreement was renewed in early 2015. The Board's strategic vision for the next ten years will be enacted through an ambitious agenda of research and engagement activities. Two of the most important initiatives to be developed during the next term are the Tropical Indigenous Ethnobotany Centre (TIEC) Partnership and the Australian Savanna Plant Identification System. We invite potential partners to discuss with us how you can help ensure, through supporting these important initiatives, that development in northern Australia is environmentally and culturally sustainable.

TROPICAL INDIGENOUS ETHNOBOTANY CENTRE (TIEC) PARTNERSHIP

BRIDGING INDIGENOUS KNOWLEDGE AND WESTERN SCIENCE IN INNOVATIVE WAYS FOR A SUSTAINABLE FUTURE.

Indigenous knowledge is recognised globally for its potential value in contemporary biodiversity conservation, management and biodiscovery. In tropical Australia, Indigenous peoples' strong and diverse presence on country presents an opportunity to work with Indigenous knowledge and management systems and strengthen community awareness of biocultural diversity. The TIEC was established in 2010 to promote and facilitate Indigenous-driven research, and is the only research unit or department dedicated to Indigenous plant knowledge in Australia. The TIEC is a partnership between Traditional Owners, the ATH, JCU's The Cairns Institute, Queensland Government, CSIRO and other government agencies and organisations. Development of the TIEC, housed at the ATH, and research projects undertaken in association with it advance through mutually beneficial partnerships. Projects aim to research and collate existing ethnobotanical data in a respectful and culturally appropriate way, and provide awareness, training and education.

The TIEC seeks substantial funding support to initiate new projects and develop its research and engagement partnerships.

AUSTRALIAN SAVANNA PLANT IDENTIFICATION SYSTEM

IS IT A WEED? A THREATENED SPECIES? POISONOUS? IS IT CULTURALLY SIGNIFICANT, IS IT NEW TO SCIENCE?

Australian savannas are globally renowned for their biodiversity, and are amongst the most intact on earth. Sustainability of development depends upon access to knowledge of this biodiversity, and the tools to allow managers and others to identify it.

The Australian Savanna Plant Identification System (ASPIS) project will produce simple and accessible online tools and apps to enable almost anybody, anywhere to accurately identify and learn about Australia's savanna plants. Focused on Australia's north, the ASPIS project will transform existing knowledge, generate new data, and harness cutting edge technologies to deliver authoritative biodiversity knowledge to a broad stakeholder community. ASPIS will be a globally significant, legacy project, the largest and most complete of its kind, covering all plant species (8500+) of Australia's tropical savanna.

The ASPIS consortium is seeking investment partnerships totaling $11.4 million over 7 years.

Leucopogon sp. Photo: Mark Newton.

ATH
Australian Tropical Herbarium

Contact us

Public reference collection opening times: Mon-Fri, 9am – 4pm.
Phone: +61 7 4232 1837
Email: enquiry@ath.org.au
Web: www.ath.org.au
Facebook: www.facebook.com/tropicalherbarium
Postal: Sir Robert Norman Building (E2), JCU Smithfield Campus, PO Box 6811, Cairns QLD 4870
Street: Sir Robert Norman Building (E2), JCU Smithfield Campus, McGregor Road, Smithfield Qld 4878
Location: E2.118K (Building E2; Room 118K)

Australian Tropical Rainforest Plants Identification System - free to use online at www.anbg.gov.au/cpbr/cd-keys/rfk/

JAMES COOK UNIVERSITY AUSTRALIA

Queensland Government

CSIRO

Australian Government
Director of National Parks