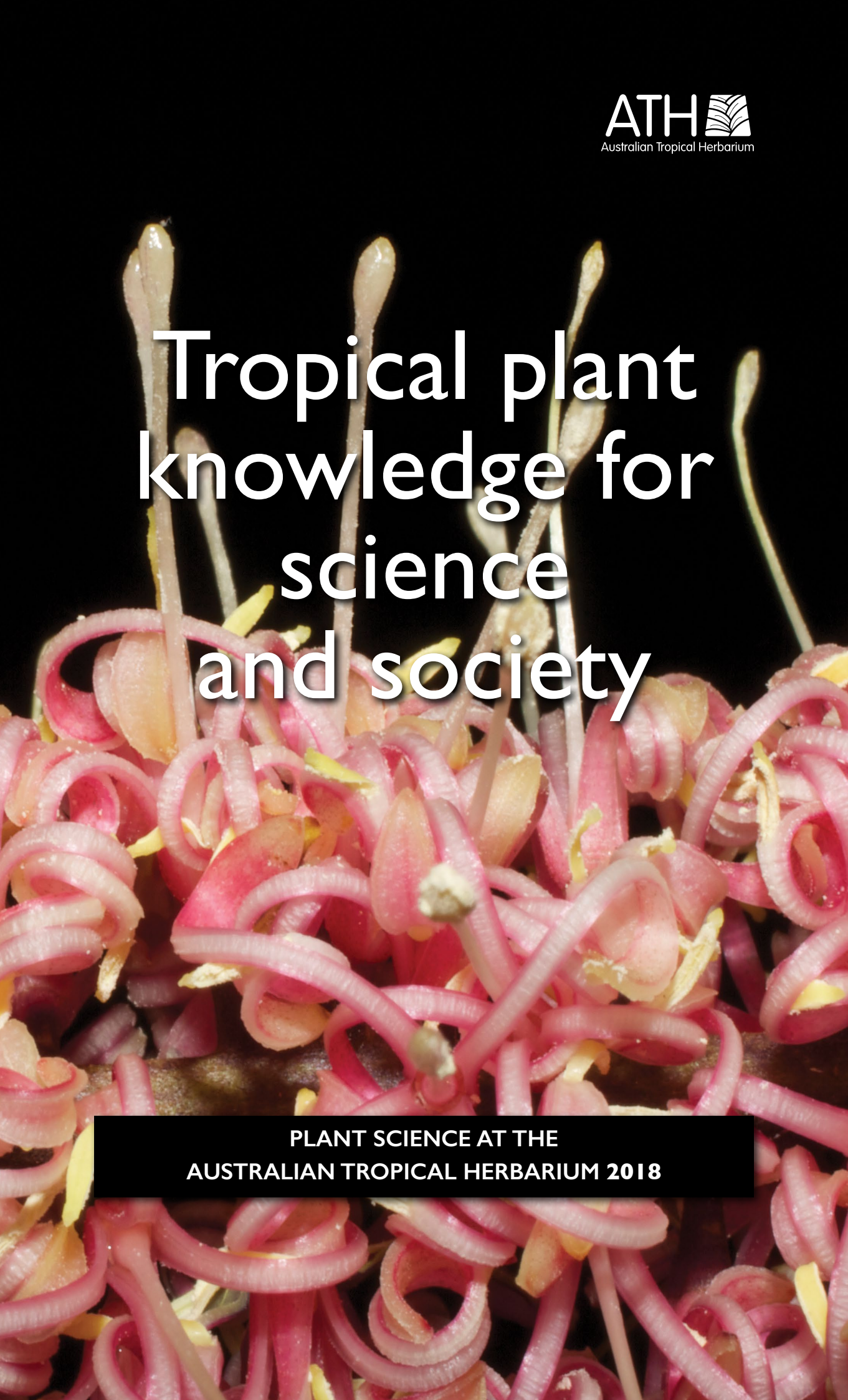
ATH
Australian Tropical Herbarium

Tropical plant knowledge for science and society



PLANT SCIENCE AT THE
AUSTRALIAN TROPICAL HERBARIUM **2018**

IMPACT STORY

A NEW PARADIGM FOR QUEENSLAND'S VEGETATION CLASSIFICATION

Land use legislation in Queensland is underpinned by the Regional Ecosystem classification framework. Regional Ecosystems are vegetation communities that are consistently associated with a particular geology, landform and soil. The vegetation communities are currently classified using standardized qualitative methods. ATH and Queensland Government botanist Eda Addicott is completing her PhD studies at JCU on developing and testing a new standard quantitative methodology for classifying vegetation communities within the Regional Ecosystem framework. The rollout of this new methodology across the State is improving the robustness, repeatability and transparency of Regional Ecosystem mapping methodology and fundamentally strengthens the evidence base for the regulation of land use in Queensland, including clearing, conservation and restoration.

Cover: *Hollandea sayeriana*. Photo: A. Lim.

CONTENTS

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 and Environment (DES), 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.

ATH Board members and Director. Top row (l–r): Mr Peter Cochrane (Chair, ATH Board), Dr Linda Broadhurst (Director, Australian National Herbarium, National Research Collections Australia, CSIRO), Prof Iain Gordon (Deputy Vice Chancellor, Division of Tropical Environments and Societies, James Cook University), Dr Gordon Guymer (Director, Queensland Herbarium, Queensland Department of Environment and Science). Second row (l–r): Dr Mark Jacobs (Assistant Director General, Queensland Department of Environment and Science), Prof Marcus Lane (Dean, College of Science and Engineering, James Cook University), Prof Andrew Young (Director, National Research Collections Australia, CSIRO), Prof Darren Crayn (Director, ATH).

Diburr *(Ficus coronata)*, a north Queensland plant of Indigenous cultural significance. Photo: G. Turpin.

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. 20).

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. TIEC is also working with researchers from the Australian Institute of Tropical Health and Medicine to assess the potential of Mbabaram medicinal plants to treat inflammatory diseases.

Project leader Gerry Turpin examining culturally significant flora on Olkola country, Cape York Peninsula. Photo: B. Menadue.

Project leader Dr Sandra Abell.

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.

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

Fungi that infect insects are common in tropical regions. Despite their abundance, they have never been taxonomically studied in Australia. Recent samples taken from ants, flies, scale insects and spiders from Australian rainforests have revealed over 150 species probably new to science. This project focuses on the genera *Akanthomyces, Cordyceps, Gibellula, Hirsutella, Hypocrella, Ophiocordyceps,* and *Torrubiella*. A systematic revision and interactive identification guide to at least 40 Australian species will be made available. 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.

A huntsman spider colonised by an entomopathogenic fungus. Photo: A. Lim.

Project leader Dr Ashley Field collecting lycophytes in Brazil for research.

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 over 45 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, named and accurately classified.

Exemplar project – Evolutionary diversity of ferns and lycophytes. Project Leader – Dr Ashley Field.

In contrast with many flowering plants, lineages of ferns and lycophytes are often very widespread, linking floras all around the world. Australian ferns and lycophytes are very diverse. Some show Gondwanan and Oceanian affinities, whereas others have apparently arrived recently by long distance dispersal from the Western Palaeotropics and the Neotropics. Research at the ATH has linked into a worldwide network of fern and lycophyte scientists to study the global evolutionary history of ferns and lycophytes from their deep time origins to recent diversification processes that are critical to their survival. New species are described as they are found.

Schizaea dichotoma, member of an ancient fern lineage. Photo: A. Field.

Project leader Eda Addicott surveying vegetation on Cape York Peninsula. Photo: M. Newton

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 governments, landholders and scientists to plan and manage the natural environment, developments and vegetation restoration. ATH staff have developed and successfully tested a new standard vegetation classification methodology for the Cape York Peninsula (CYP). Future work aims to implement this method across the other bioregions mapped by ATH staff (Einasleigh Uplands and Wet Tropics) as well as bioregions across the rest of Queensland.

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 nearly 250 years of Western scientific endeavour, and thousands of years of experimentation by Indigenous Australians. This wealth of knowledge can greatly improve our ability to sustainably manage our biodiversity, **but can only be utilised if the species name is accurately determined.** 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.

Project leader Frank Zich (left) in the ATH collections with Michael Lovave, Curator, National Botanical Gardens, Papua New Guinea.

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

The Australian Tropical Rainforest Plants identification system (http://www.canbr.gov.au/cpbr/cd-keys/rfk7-temp/RFK7/key/RFK7/Media/Html/index_rfk.htm#) 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 7th edition was released in 2018, which extended the geographical coverage to include the whole of the Australian tropics. A key to Australia's tropical ferns will be launched soon, and the team is working to initiate an even more exciting project: the Australian Savanna Plant Identification System (see p. 20).

Front page of the online Australian Tropical Rainforest Plants identification system.

Exemplar project – Mountain plant conservation. Project Leader – Stuart Worboys.

Herbarium collections provide important information about plant distributions and therefore about the environmental requirements (niches) of species. By combining data from existing collections with extensive new field survey data for species distribution modeling analyses and climate tolerance experiments, we are predicting the impact of climate change on the rare and endemic plant species of Australia's tropical mountain tops, and taking precautionary action to secure them in ex-situ living collections in partnership with seven public botanic gardens, and two seed banks.

Project leader Stuart Worboys enjoying a break from fieldwork on Bell Peak, south of Cairns. Photo: D. Craven.

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 leading projects that are determining the nature and extent of climate change threats to the plant species of tropical mountains, many of which are found nowhere else on Earth.

Rhododendron lochiae, Australia's only native Rhododendron, which is restricted to the mountains of Queensland's Wet Tropics. Photo: D. MacLeod.

Garcinia zichii, one of six native Australian species of the mangosteen genus. This species was named by ATH Adjunct researcher Dr Wendy Cooper in honour the Collections Manager of the Australian Tropical Herbarium, Mr Frank Zich. Photo: J. Dowe.

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.

Exemplar project – The origins of mangosteen. Project Leader – Rismita Sari.

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.

Project leader Rismita Sari (centre left) with field assistants on the hunt for wild mangosteen species in Indonesia.

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.

Exemplar project – The Sunda-Sahul Floristic Exchange. Project Leaders – Ms Elizabeth Joyce and Prof Darren Crayn.

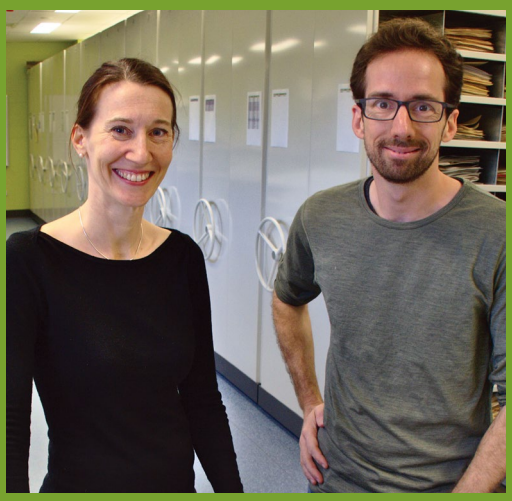
Understanding the processes that generate and maintain biodiversity in tropical ecosystems is vital for informing conservation decisions. The southeast Asian archipelago is one of the most biogeographically interesting places on Earth. It lies at the convergence of the Sunda and Sahul continental shelves, which collided from about 23 million years ago allowing plant species to migrate between previously isolated Sundanian and Sahulian floras. This study uses molecular phylogenies of multiple lineages to determine the dynamics of this exchange through time, and to better understand how it contributed to the assembly and evolution of the floras of Asia, Australasia and the Pacific.

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

Project co-leader Lizzy Joyce.

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 the efficiency and quality of 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.



Project leaders Dr Katharina Nargar and Dr Lars Nauheimer. Photo: S. Worboys.

An orchid, *Dockrillia teretifolia*. Photo: F. Venter .

Exemplar project – Taxonomy of orchids. Project Leaders – Dr Katharina Nargar and Dr Lars Nauheimer.

Australia harbours a rich and highly distinctive orchid flora. Based on DNA sequence data we are discovering the evolutionary relationships (phylogeny) among orchids. The results provide a scientific evidence base for re-examining controversial taxonomies in order to improve our classification system. Our studies cover a broad range of Australian orchids, such as the genus Thelymitra, and the highly diverse orchid tribe Diurideae which harbours the majority of Australian orchid species including many threatened species. Phylogenetic evidence is used to improve orchid classifications at higher taxonomic levels (e.g. at genus level) as well as to answer questions about species, such as "how many species does this group of similar-looking plants represent?".

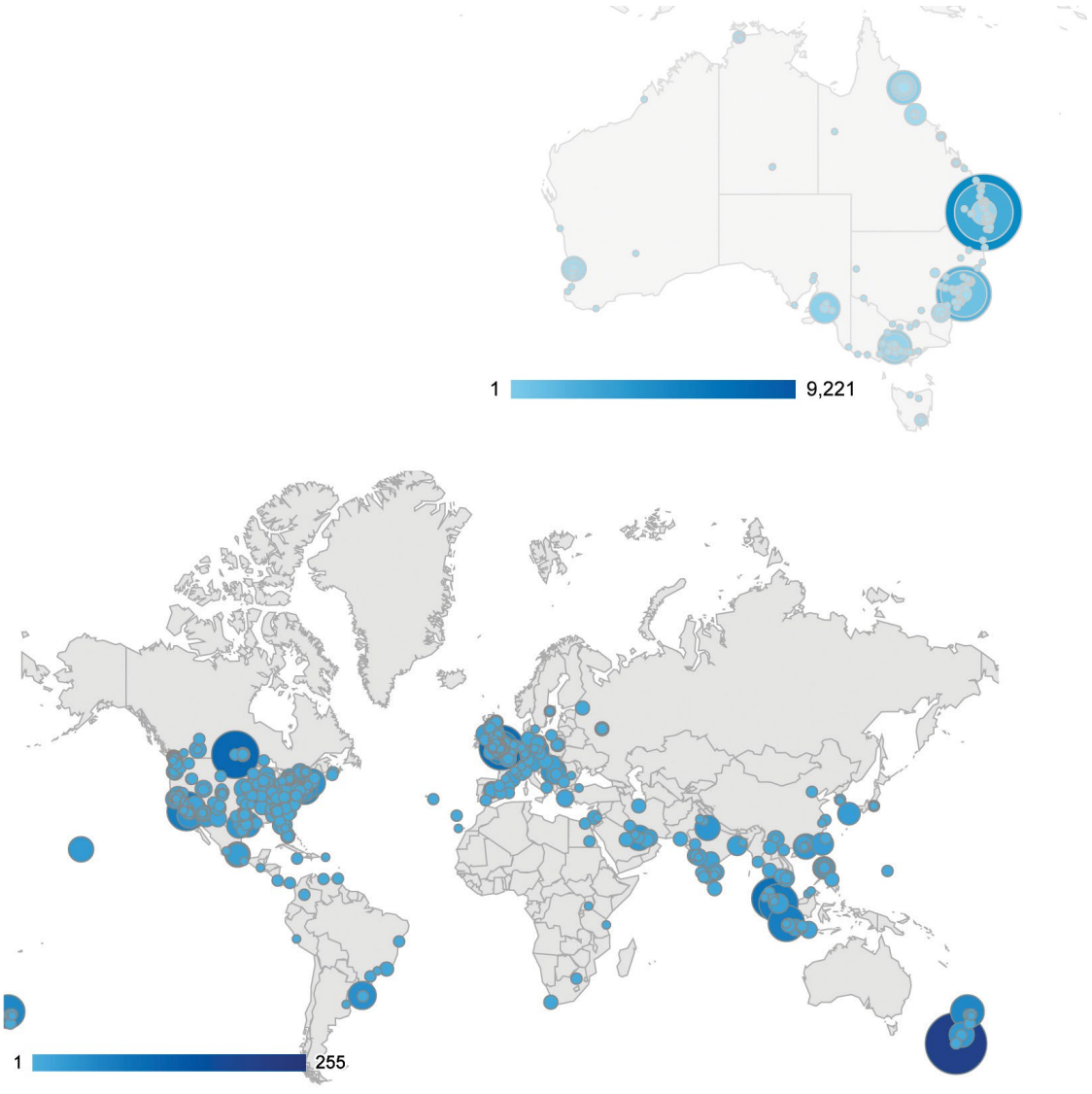
SCIENCE DELIVERY–LOCAL TO GLOBAL

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

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 in Brazil, China, Denmark, Estonia, France, Indonesia, Japan, New Zealand, Papua New Guinea, Sweden, 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 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.

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 topics as diverse 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 to identify and learn about north Queensland plants.

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

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

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 17,300 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 nearly 22,000 samples representing over 3,000 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.

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

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 of B.P.M. (Bernie) Hyland, the eminent and pioneering botanist of Australia's northern rainforests, 9,300 collections of Bruce Gray, and orchid specimens from the collection of Alec Dockrill.

Melicope xanthoxyloides. Photo: J. Dowe.

SUMMARY OF ACHIEVEMENTS 2018

SCIENCE DELIVERY – LOCAL TO GLOBAL

Our science was communicated broadly through:

- 33 peer-reviewed publications
- 2 Regional Ecosystem mapping products
- 5 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:

- $464,160 external research grant income
- collaborations with 85 scientists in 10 countries.

SHARING OUR KNOWLEDGE

ATH staff shared our knowledge through:

- training and knowledge sharing workshops delivered to Indigenous groups in north Queensland;
- plant identification training delivered through workshops to the public and to government and industry stakeholders;
- responding to 32 scientific enquiries and 76 requests for plant identifications for external stakeholders;
- hosting 219 public visitors participating in school, public and professional group tours;
- hosting 32 scientists undertaking research at the ATH;
- 26 representative and leadership roles on international, national, and local bodies;
- communicating through numerous media items.

BUILDING, IMPROVING AND MOBILISING OUR COLLECTIONS

- 1,998 herbarium specimens accessioned into CNS, 2,066 collection records edited and 1,307 specimens re-determined.
- 250 samples accessioned into the DNA and Tissue Bank, which now contains over 19,000 samples.
- Over 13 million specimen records downloaded in more than 85,000 download events by a range of external user groups through the Atlas of Living Australia portal (ala.org.au).

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

PUBLICATIONS

SCIENTIFIC PAPERS

Addicott E, Laurance S, Lyons M, Butler DW, Neldner VJ (2018) When rare species are not important: linking plot-based vegetation classifications and landscape-scale mapping in Australian savanna vegetation. *Community Ecology* 19, 67-76.

Addicott EP, Newton M, Laurance S, Neldner VJ, Laidlaw M, Butler DW (2018) A new classification of savanna plant communities on the igneous rock lowlands and Tertiary sandy plain landscapes of Cape York Peninsula bioregion. *Cunninghamia* **18,** 29-72.

Appelhans MS, Wen J, Duretto M, **Crayn D,** Wagner WL (2018) Historical biogeography of Melicope (Rutaceae) and its close relatives with a special emphasis on Pacific dispersals. *Journal of Systematics and Evolution* **56**, 576-599.

Bauret L, **Field AR**, Gaudeul M, Selosse M-A, Rouhan G (2018) First insights on the biogeographical history of *Phlegmariurus* (Lycopodiaceae), with a focus on Madagascar. *Molecular Phylogenetics and Evolution* **127**, 488-501.

Biffin E, Barker WR, **Wannan B**, Liang Y-S (2018) The phylogenetic placement of Australian Linderniaceae and implications for generic taxonomy. *Australian Systematic Botany* **31**, 241-251.

Brownsey PJ, Perrie LR, Field AR (2018) Taxonomic notes on the New Zealand flora: lectotypes in Isoetaceae and Lycopodiaceae. New Zealand Journal of Botany 56, 396-405.

Bush A, Catullo RA, Mokany K, **Thornhill AH**, Miller JT, Ferrier S (2018) Truncation of thermal tolerance niches among Australian plants. *Global Ecology and Biogeography* **27**, 22-31.

Crayn DM (2018) Plant systematics and biogeography in the Australasian tropics. *Australian Systematic Botany* **31**, i-iii.

Dowe JL (2018) Philip John MacMahon: Brisbane Botanic Gardens curator 1889 – 1905 and his vision of Brisbane as a 'City of Palms'. *Queensland History Journal* **23**, 507-521.

Dowe JL (2018) 'Such Superfluity of Genera': Ferdinand Mueller's Criticism of Generic Limits in Wendland and Drude's 'Palmae Australasicae' of 1875. *Historical Records of Australian Science* **29,** 82-90.

Dowe JL (2018) Marianne North's paintings of Australian gardens, 1880-81. *Australian Garden History* **30**, 12-15.

Dowe JL (2018) *Livistona leichhardtii* is the correct name for *Livistona lorophylla* (Arecaceae). *Nuytsia* 29, 245-250.

Field AR (2018) *Phlegmariurus vanuatuensis* (Huperzioideae, Lycopodiaceae) a new species from Vanuatu, re-circumscription of P. *nummulariifolius* and new combinations in Phlegmariurus. PhytoKeys **109**, 53-66.

Gagul J, Simpson L, Crayn DM (2018) *Elaeocarpus carbinensis* J.Gagul & Crayn (Elaeocarpaceae), a new species endemic to the Mt Carbine Tableland of northeast Queensland, Australia. *Austrobaileya* **10**, 247-259.

Gagul JN, Sands MJS, Gideon O, Hughes M (2018) A revision of Begonia Sect. *Symbegonia* on New Guinea. *Edinburgh Journal of Botany* **75**, 127-159.

Gagul JN, Tng DYP, **Crayn DM** (2018) Fruit developmental biology and endosperm rumination in *Elaeocarpus ruminatus* (Elaeocarpaceae), and its taxonomic significance. *Australian Systematic Botany* **31**, 409-419.

Gruenstaeudl M, Borsch T, Di Vincenzo V, **Nauheimer L**, Wondafrash M, Demissew S, Kamau P (2018) Evolutionary diversification of the African achyranthoid clade (Amaranthaceae) in the context of sterile flower evolution and epizoochory. *Annals of Botany* 122, 69-85.

Joyce EM, Crayn DM, Lam VKY, Gerelle WK, Graham SW, **Nauheimer L** (2018) Evolution of *Geosiris* (Iridaceae): historical biogeography and plastid-genome evolution in a genus of non-photosynthetic tropical rainforest herbs disjunct across the Indian Ocean. *Australian Systematic Botany* **31**, 504-522.

Miller JT, Jolley-Rogers G, Mishler BD, **Thornhill AH** (2018) Phylogenetic diversity is a better measure of biodiversity than taxon counting. *Journal of Systematics and Evolution* **56**, 663-667.

Moner AM, Furtado A, Chivers I, Fox G, **Crayn D**, Henry RJ (2018) Diversity and evolution of rice progenitors in Australia. *Ecology and Evolution* **8**, 4360-4366.

Nargar K, Molina S, Wagner N, **Nauheimer L, Micheneau C**, Clements MA (2018) Australasian orchid diversification in time and space: molecular phylogenetic insights from the beard orchids (*Calochilus*, Diurideae). *Australian Systematic Botany* **31**, 389-408.

Nauheimer L, Schley RJ, Clements MA, **Micheneau C, Nargar K** (2018) Australasian orchid biogeography at continental scale: Molecular phylogenetic insights from the Sun Orchids (*Thelymitra*, Orchidaceae). *Molecular Phylogenetics and Evolution* **127**, 304-319.

Nuske SJ, Anslan S, Tedersoo L, Bonner MTL, Congdon BC, **Abell SE** (2018) The endangered northern bettong, *Bettongia tropica*, performs a unique and potentially irreplaceable dispersal function for ectomycorrhizal truffle fungi. *Molecular Ecology* **27**, 4960-4971.

Purcell MF, **Thornhill AH**, Wallenius TC, Yeates DK, Rowell DM (2018) Plant host relationships of three lineages of the gall-inducing fly *Fergusonina* Malloch (Diptera: Fergusoninidae) on *Eucalyptus* L'Hérit. *Arthropod-Plant Interactions* **12**, 133-145.

Amylotheca dictyophleba.

Renner MAM, **Worboys S** (2018) Two additional *Chiastocaulon* species (Marchantiophyta: Plagiochilaceae) from the Wet Tropics Bioregion of north-eastern Queensland. *Australian Systematic Botany* **31**, 487-494.

Simpson L, Clements MA, **Crayn DM, Nargar K** (2018) Evolution in Australia's mesic biome under past and future climates: Insights from a phylogenetic study of the Australian Rock Orchids (*Dendrobium speciosum* complex, Orchidaceae). *Molecular Phylogenetics and Evolution* **118**, 32-46.

Testo W, **Field A**, Barrington D (2018) Overcoming among-lineage rate heterogeneity to infer the divergence times and biogeography of the clubmoss family Lycopodiaceae. *Journal of Biogeography* **45**, 1929-1941.

Testo W, Øllgaard B, **Field A,** Almeida T, Kessler M, Barrington D (2018) Phylogenetic systematics, morphological evolution, and natural groups in neotropical *Phlegmariurus* (Lycopodiaceae). *Molecular Phylogenetics and Evolution* **125**, 1-13.

Wilson GW, Wilson RF (2018) Mixed-species foraging flocks of birds in rainforest at Kuranda, Queensland. *North Queensland Naturalist* **48,** 46-53.

Yap JYS, Rossetto M, Costion C, **Crayn D**, Kooyman RM, Richardson JE, Henry R (2018) Filters of floristic exchange: How traits and climate shape the rain forest invasion of Sahul from Sunda. *Journal of Biogeography* **45**, 838-847.

Zich FA, Ford AJ (2018) *Tecomanthe burungu* (Bignoniaceae), a new species from northern Queensland. *Australian Systematic Botany* **31**, 481-486.

GENERAL PUBLICATIONS AND REPORTS (UNREFEREED)

Crayn D (2018) Plant systematics and biogeography in the Australasian tropics. *Australian Systematic Botany* **31**, i-iii.

Cui L (2018) Unravelling evolutionary relationships in tropical carnivorous plants using next-generation DNA sequencing. Internal report, CSIRO vacation scholarship program. Supervised by **K Nargar, L Nauheimer, D Crayn** and M Clements.

Orel H (2018) Molecular phylogeny and spatio-temporal evolution of *Bulbophyllum* orchids. Internal report, CSIRO vacation scholarship program. Supervised by **K Nargar, L Simpson, L Nauheimer**, and M Clements.

Simpson L (2018). Resolving species concepts in the contentious Dendrobium speciosum complex using molecular data. Final Report to the Australian Orchid Foundation. Published online https://www.australianorchidfoundation.org.au/280-2011/

WWF-Australia 2018 (co-authors including **Abell S, Nuske S**) Northern Bettong - Population Status, Viability and Impact of Fire (Final Project Report), Final Report prepared by WWF-Australia, Sydney NSW, https://www.wwf.org.au/news/news/2018/northern-bettongs-facing-extinction-threat#gs.1ik6c4.

THESES

Roeble E (2018) Modelling the vulnerability of endemic montane flora to climate change in the Australian Wet Tropics. MSc thesis, Imperial College London. Supervised by Lloyd J (Imperial College London), **Crayn D**.

RESEARCH AND COMMUNITY PRESENTATIONS (PRESENTER UNDERLINED)

Crayn D. The past informs the future: evolutionary and biogeographical history, and management of Australia's tropical flora. Centre for Tropical Environmental and Sustainability Science seminar series, JCU Cairns.

Crayn D. Australia's northern flora – frontier for biodiscovery. Centre for Molecular Therapeutics 2018 retreat, Palm Cove.

Crayn D. Science and partnerships to secure a future for the Wet Tropics' climate-threatened flora. Centre for Tropical Environmental and Sustainability Science 2018 retreat, Palm Cove.

Crayn D ,**Kerrigan R**. Alpha taxonomy of the AA genome *Oryza* species in Australia. Wild rice in Australia meeting, Cairns.

Cui, L. Unravelling evolutionary relationships in tropical carnivorous plants using next-generation DNA sequencing. NRCA summer student symposium, CSIRO, Canberra.

Field A. Using phylogenetics to investigate continental, biome and habitat shifts and radiations in *Phlegmariurus* (Lycopodiaceae). ASBS 2018 conference, Brisbane.

Joyce E, Crayn D. The SAD model - an uplifting tale of how migration stimulated the diversification of the Malesian flora. Centre for Tropical Environmental and Sustainability Science Annual Conference, Cairns.

Joyce E, Crayn D. The SAD model - an uplifting tale of how migration stimulated the diversification of the Malesian flora. ASBS 2018 conference, Brisbane.

Joyce E, Crayn D. New Guinea: a major generator of Malesian plant diversity? Evidence from multi-lineage analysis of diversification through time. ATBC 2018 conference, Kuching, Malaysia. WINNER Alwyn Gentry Award for best student oral presentation.

Joyce E. *Geosiris* – the sexiest plant alive. JCU College of Science and Engineering Postgraduate student conference, Cairns.

Joyce E. Understanding the origins of the northern Australian flora – the Sunda-Sahul floristic exchange. eFlower school, Oak Spring, USA.

Joyce E, Crayn D, Lam V, Gerelle W, Graham S, **Nauheimer L**. Evolution of *Geosiris* (Iridaceae): historical biogeography and plastid-genome evolution in a genus of non-photosynthetic tropical rainforest herbs disjunct across the Indian Ocean. ASBS 2018 conference, Brisbane.

Kennedy H, Bruhl J, Andrew R, Telford I, **Crayn D**. Integrative taxonomic revision of *Melichrus* R.Br. (Ericaceae subfam. Epacridoidae). ASBS 2018 conference, Brisbane. [poster] **WINNER CSIRO Prize for best poster**.

Nargar K, **Micheneau C**, Atsawawaranunt K, **Nauheimer L**, Clements MA. Australasian orchid diversification in space and time: phylogenetic insights from *Dendrobiinae* (Orchidaceae). ASBS 2018 conference, Brisbane.

Nargar K, **Molina S**, Wagner N, **Nauheimer L, Micheneau C,** Clements M (2018): Australasian orchid diversification in space and time: phylogenomic insights from the beard orchids (*Calochilus*, Diurideae). Monocots VI: 6th International Conference on Comparative Biology of Monocotyledons, Natal, Brazil [poster].

Nargar K, Simpson L, Atsawawaranunt AK, **Nauheimer L**, Clements M. Evolution of hyperdiverse Dendrobieae in time and space – phylogenomic insights. Monocots VI: 6th International Conference on Comparative Biology of Monocotyledons, Natal, Brazil. Invited.

Nargar K, Wagner N, Mertin A, **Nauheimer L**, Clements M. Evolution of Australia's rich endemic orchid flora in time and space – phylogenomic insights. Monocots VI: 6th International Conference on Comparative Biology of Monocotyledons, Natal, Brazil. Invited.

Nargar K, Wagner N, **Nauheimer L**, Clements M: Evolution of Australia's terrestrial orchid flora: phylogenomic insights. National Collections and Marine Infrastructure (NCMI) Forum, CSIRO, Canberra.

Nauheimer L, Clements MA, **Schley R, Micheneau C, Nargar K**. Resolving complex evolutionary relationships in the sun orchids (*Thelymitra*, Orchidaceae) – insights through molecular phylogenetics and phylogenomics. ASBS 2018 conference, Brisbane.

Orel, H. Molecular phylogeny and spatio-temporal evolution of *Bulbophyllum* orchids. NRCA summer student symposium, CSIRO, Canberra.

Simpson L. Evolution of the orchids through time and space – how biogeography has shaped orchid biodiversity. Annual General Meeting, Australian Orchid Foundation, Melbourne.

Turpin G. Indigenous engagement with science. ASBS 2018 conference, Brisbane.

PARTICIPANTS IN ACTIVITIES 2018

STAFF

Queensland Government

Ms Eda Addicott (Principal Botanist)

Mr Peter Bannink (Senior Computer Support Officer)

Dr Ashley Field (Senior Botanist)

Mr Mark Newton (Senior Technical Officer)

Mr Gerry Turpin (Ethnobotanist)

CSIRO

Dr Katharina Nargar (Research Scientist)

Ms Tonja Sankey (Technical Officer)

Mr Frank Zich (Collections Manager)

James Cook University

Prof Darren Crayn (Director)

Ms Robyn Fortune (Administration)

Ms Melissa Harrison (Laboratory Manager)

Ms Andrea Lim (Administration)

External grants

Ms Raelee Kerrigan (Scientific Officer)

Dr Lars Nauheimer (Postdoctoral Fellow)

Dr Stephanus (Fanie) Venter (Postdoctoral Fellow)

Mr Stuart Worboys (Laboratory and Technical Support Officer)

RESEARCH STUDENTS

Ms Eda Addicott

Ms Gizem Bilgin (CSIRO Vacation Scholar)

Ms Kaylene Bransgrove

Ms Louise Cui (CSIRO Vacation Scholar)

Ms Samantha Forbes

Ms Janet Gagul

Ms Melinda Greenfield

Mr Patrick Hannah (CSIRO Vacation Scholar)

Ms Lizzy Joyce

Ms Kate O'Hara (CSIRO Vacation Scholar)

Mr Harvey Orel (CSIRO Vacation Scholar)

Ms Claudia Paz

Mr James Perkins (CSIRO Vacation Scholar)

Ms Elizabeth Roeble (Imperial College London/JCU)

Ms Rismita Sari

Mr Arun Singh Ramesh

Ms Lalita Simpson

ADJUNCT RESEARCHERS

Dr Sandra Abell

Dr Charles Clarke

Dr Wendy Cooper

Dr Craig Costion

Dr John Dowe

Mr Bruce Gray

Dr Claire Micheneau

Dr Caroline Pannell

Dr Caroline Puente-Lelièvre

Dr Andrew Thornhill

Dr Natascha Wagner

Mr Gary Wilson

VOLUNTEERS

Dr Charles Clarke

Ms Anna Cole

Mr Roger Fryer

Mrs Mary Gandini

Ms Nicky Horsfall

Dr Robert Jago

Ms Debbie Parsons

Mr Dale Perkins

Mr Tristram Richardson

Ms Sandra Suttie

Ms Heather Winsor

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 1st April 2015 the Joint Venture partners agreed a further 10-year term.

The Sir Robert Norman Building incorporating the Australian Tropical Herbarium. Photo: B. Newton.

OUR FUTURE

Ethnobotanist Gerry Turpin.

The ATH joint venture agreement was renewed in early 2015. The Board's strategic vision for 2015–2025 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.

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

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.canbr.gov.au/cpbr/cd-keys/rfk7-temp/RFK7/key/RFK7/Media/Html/index_rfk.htm#

JAMES COOK UNIVERSITY AUSTRALIA

Queensland Government

CSIRO

Australian Government
Director of National Parks