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TROPICAL PLANT

KNOWLEDGE FOR

SCIENCE

AND SOCIETY

2020

IMPACT STORY

DIY RAINFOREST PLANT IDENTIFICATION FOR EVERYBODY

The study, use, and conservation of rainforest plants depends on being able to quickly and accurately identify the species. The tools and skills required are rarely widely available to the public, however. In response, we have built an online, free-to-use, identi cation system that allows anyone, anywhere to easily identify Australian tropical rainforest plants. The 'Rainforest Key' is used worldwide by thousands of di erent people every month, supporting research, understanding, management and enjoyment of these unique plants and the ecosystems they comprise.

Access the key at https://apps.lucidcentral.org/rainforest

science delivery

38 scienti c publications, reports and articles

$523k external research grant income

500 samples accessioned into DNA and tissue bank

19 research talks, public seminars and lectures

knowledge sharing

116 collaborators in 17 countries

37 national and international representative and leadership roles

capacity building

18 research students

1859 specimens accessioned into herbarium collections

Cover art: Neolamarckia cadamba, photo Gary Wilson.

CONTENTS

The Australian Tropical Herbarium (ATH) is a joint venture of the Commonwealth Scienti c 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; o ers training, inspiration and engagement withTa(opical 8

UNDERSTANDING PATHOGENS

DISCOVERING NEW SPECIES

Herbarium collections are the real frontiers of plant

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 identi cation 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 – Ms 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 sta have developed and successfully tested a new standard vegetation classi cation methodology for Cape York Peninsula (CYP). This method has been implemented across the Gulf Plains and North West Highlands Bioregions. Future work aims to implement this across other bioregions mapped by ATH sta (Einasleigh Uplands and Wet Tropics) and the rest of Queensland. The rollout of this new methodology is improving the robustness, repeatability and transparency of Regional Ecosystem mapping methodology and fundamentally strengthens the evidence base

ENVIRONMENTAL BIOSECURITY

The plant biosecurity group develops basic and applied research programs to understand the ecological traits (e.g. seed germination, competitive ability) and evolutionary processes (e.g. polyploidy, rapid adaptation) that cause introduced plants and fungi to become invasive, and how that knowledge can be better used to reduce their impact on the environment and the economy. We have a broad range of national and international collaborators, allowing for cross-continental studies of species of interest. We o er our capabilities to the public and private sector, and help to design and to develop case-speci c targeted studies. We also develop outreach activities to promote public awareness about good land management practices.

Exemplar project – Fire and weeds -
Project leaders - Dr Daniel Montesinos and Mr Gerry Turpin.

Invasive weeds can produce thousands of seeds per year, which can remain viable in the soil for decades despite above-ground control actions such as spraying. Management of this soil seed bank is challenging, and often overlooked, but we know that numerous weeds experience increased germination after re. This could be used to our advantage if we understand the conditions that can trigger massive germination events, so we can act immediately after the re to eliminate the newly germinated weeds. We are assessing which re conditions increase weed seed germination, and for which weed species, to assess cost-e ective post- re actions to deplete soil seed banks. This project is undertaken as a collaboration with Traditional Owners, and other land managers.

Mr Gerry Turpin (Mbabaram Traditional Owner and ATH Ethnobotanist) initiating a cultural burn on Mbabaram country. Photo: D. Montesinos.

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 Western scienti c 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 di cult to access by non-specialists: highly technical, expensive and held in distant libraries. The development and deployment of web-based interactive identi cation systems and apps targeted at the non-specialist enables almost anybody, anywhere to identify and learn about Australia's ora. This helps all community sectors to achieve their land and environmental assessment, management, educational, scienti c and recreational goals. Principal bene ciaries include the resources, agricultural and horticultural industries, Indigenous land managers, private and public conservation estate managers, students, tourists, and scienti c researchers.

Exemplar project – Australian Tropical Rainforest Plants Identi cation System.
Project Leader – Mr Frank Zich.

The 8th edition of the Australian Tropical Rainforest Plants identi cation system was released in late 2020 as an easy to use, free, online system (https://apps.lucidcentral.org/rainforest/) and mobile app that enables almost anybody, anywhere to identify over 2760 species of tropical rainforest plants in Australia. The uptake by the user community has been overwhelming – over 2,000 users and up to 13,000 page visits per month.

A species pro le from Edition 8 of the online Australian Tropical Rainforest Plants identi cation system.

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. 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.

Exemplar project – Tropical mountain plant conservation.
Project Leader – Mr 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 eld 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. Simultaneously, we are taking precautionary action to secure them in ex-situ living collections in partnership with seven public botanic gardens, and two seed banks. Find out more about this project at www.tromps.org.au

PIECING TOGETHER THE ORIGINS AND EVOLUTION OF AUSTRALIA'S FLORA

From where did our ora 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 ora 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 separated oras. 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 oras of Asia, Australasia and the Paci c.

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 in partnership with First Nations people on traditional plant use, and the provision of identi cation resources for Australia's tropical ora.

Beyond Australia, ATH sta 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.

ATH research has global impact: our scienti c publications have been cited thousands of times by researchers all over the world, and the Australian Tropical Rainforest Plants online identi cation 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 identi cation system.

SHARING OUR KNOWLEDGE

COMMUNITY ENGAGEMENT, SERVICE, AND REPRESENTATIVE ROLES

ATH sta 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 Identi cation Courses, we deliver, in partnership with the Wet Tropics Management Authority, 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, Indigenous Rangers, students and interested public.

ATH sta have delivered many other workshops to community and professional groups on diverse topics as plant pathogens, re in the landscape, techniques for documenting cultural plant use, and plant classi cation.

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

In 2020 ATH sta served the community through leadership and advisory roles on 37 representative bodies, including various Councils, Advisory and Scienti c Committees and Reference Groups for Commonwealth, State and Local Governments, not-for-pro t groups and societies, and the IUCN.

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

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

RESEARCH TALKS, COMMUNITY PRESENTATIONS AND LECTURES

Barrett M (2020) Collecting and Identifying Australian Polypores. Virtual presentation to 0<&2PPXQLW\ $SSOLHG 0\FRORJ\ DQG /HDUQLQJ Lab, Aug. 2020, Melbourne

Bloesch Z (2020) Introduction to research program, College of Science and Engineering, James Cook University, Cairns, March.

Bloesch Z (2020) Final seminar. Honours program, College of Science and Engineering, James Cook University, Cairns, Oct. 19.

Crayn D (2020) Securing a future for Australia's climate-threatened endemic tropical montane ÁRUD $Q H[VLWX FRQVHUYDWLRQ DSSURDFKHV on multidisciplinary science and multi-institutional SDUWQHUVKLSV ,QVWLWXWH RI %LRORJ\ 8QLYHUVLWÀW Leipzig (Germany) seminar series, Nov. 26.

Crayn D (2020) Species. Lecture in 'Tropical Flora of Australia' (BZ3620/5620), JCU, June.

Crayn D (2020) Introduction to Phylogenetics. Lecture in 'Tropical Flora of Australia' (BZ3620/5620), JCU, June.

Crayn D (2020) Uses of phylogenies. Lecture in 'Tropical Flora of Australia' (BZ3620/5620), JCU, June.

Crayn D (2020) Biogeography. Lecture in 'Tropical Flora of Australia' (BZ3620/5620), JCU, June.

Field AR (2020) Using phylogenetics to investigate continental, biome and habitat shifts and radiations in Phelgmariurus (Lycopodiaceae). Centre for Tropical Environmental and Sustainability Science (TESS), James Cook University, Cairns, Apr. 29. Video: https://mediasite.jcu.edu.au/Mediasite/Play/5aaed48f8f834512a6af5618d44721761d

Joyce EM, Crayn D (2020) The Sunda-Sahul Floristic Exchange through space and time: new insights into a classic biogeographic hotspot. ,QWHUQDWLRQDO +XPERROGW 'D\ V\PSRVLXP YLUWXDO organized by the Centre for Biodiversity Analysis, Canberra, Sep. 17.

Joyce EM (2020) Understanding the Sunda-Sahul Floristic Exchange through space and WLPH ,QVWLWXWH RI %LRORJ\ 8QLYHUV (Germany) seminar series, Nov. 26.

Montesinos D (2020) Ecological interactions for sustainable agriculture and forestry. Centre for Tropical Environmental and Sustainability Science (TESS), James Cook University, Cairns, Mar. 25. Video: https://mediasite.jcu.edu.au/Mediasite/Play/caa1e684979c45b286a91dae-60f7a8211d

Nargar K (2020) Mobilising collections through genomics. CANBR Science Review, talk. Feb. 17.

Nargar K (2020) Genomic insights into the origin DQG GLYHUVLÀFDWLRQ RI WKH $XVWUDO Canberra Orchid Society invited talk. Feb 05.

Nargar K, Schmidt-Lebuhn AL (2020) Plant Systematics and Population Genetics. CANBR Science Review, talk, Feb. 17

Nargar K, Lauderau C, Pignal M, Clements M (2020): Orchid conservation in New Caledonia. 10th 3DFLÀF ,VODQG &RQVHUYDWLRQ &RQ invited talk, Nov. 25.

Nargar K (2020) Genomics for Australian Plant ,QLWLDWLYH 1DWLRQDO &RO-HFWLRQV VWUXFWXUH $QQXDO)RUXP &6,52 WDO

Nargar K (2020). Assembly and evolution of $XVWUDOLD·V RUFKLG ÁRUD $WODV RI A 10th anniversary webinar, invited talk, Nov. 04.

Video: https://webcast.csiro.au/#/webcasts/alaseminar

ATH PERSONNEL 2020

STAFF

QUEENSLAND GOVERNMENT

Dr Eda Addicott (Principal Botanist)
Mr Peter Bannink (Senior Computer Support O cer)
Dr Ashley Field (Senior Botanist)
Mr Mark Newton (Senior Technical O cer)
Mr Gerry Turpin (Ethnobotanist)

CSIRO

Dr Katharina Nargar (Research Scientist)
Mr Frank Zich (Collections Manager)

JAMES COOK UNIVERSITY

Prof Darren Crayn (Director)
Dr Daniel Montesinos (Senior Research Fellow)
Dr Matthew Barrett (Postdoctoral Research Fellow)
Ms Melissa Harrison (Laboratory Manager)
Mr Stuart Worboys (Technical and Project O cer)
Ms Nyoka Hrabinsky (Research Assistant)
Ms Robyn Fortune (Administration)

EXTERNAL GRANTS

Ms Raelee Kerrigan (Scienti c O cer)
Dr Lars Nauheimer (Postdoctoral Research Fellow)
Dr Stephanus (Fanie) Venter (Postdoctoral Research Fellow)
Ms Maricris Bismar (Laboratory Technician)

RESEARCH STUDENTS

Ms Eda Addicott (completed 2020)
Ms Zoe Bloesch (completed 2020)
Ms Kaylene Bransgrove
Mr Patrick Cooke
Ms Samantha Forbes
Ms Janet Gagul
Ms Melinda Green eld
Ms Lizzy Joyce
Ms Helen Kennedy
Ms Kali Middleby
Mr Dale Perkins
Ms Rismita Sari
Mr Arun Singh Ramesh
Ms Alexandra Rozhkova
Ms Lalita Simpson (completed 2020)
Mr Gerry Turpin
Ms Vagi Waiin-Adu (completed 2020)
Mr Karma Yeshi

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Mr Bruce Gray
Dr Caroline Pannell
Dr Andrew Thornhill
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Ms Leesa Carlisle-Brown
Ms Vicki Crofton
Mr Roger Fryer
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Ms Evelyn Jung
Ms Parneet Kaur
Ms Claudine Marzik
Ms Pamela Schultz
Ms Pam Tacheci
Ms Heather Winsor
Ms Sharren Wong
Ms Isabel Zorn

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.

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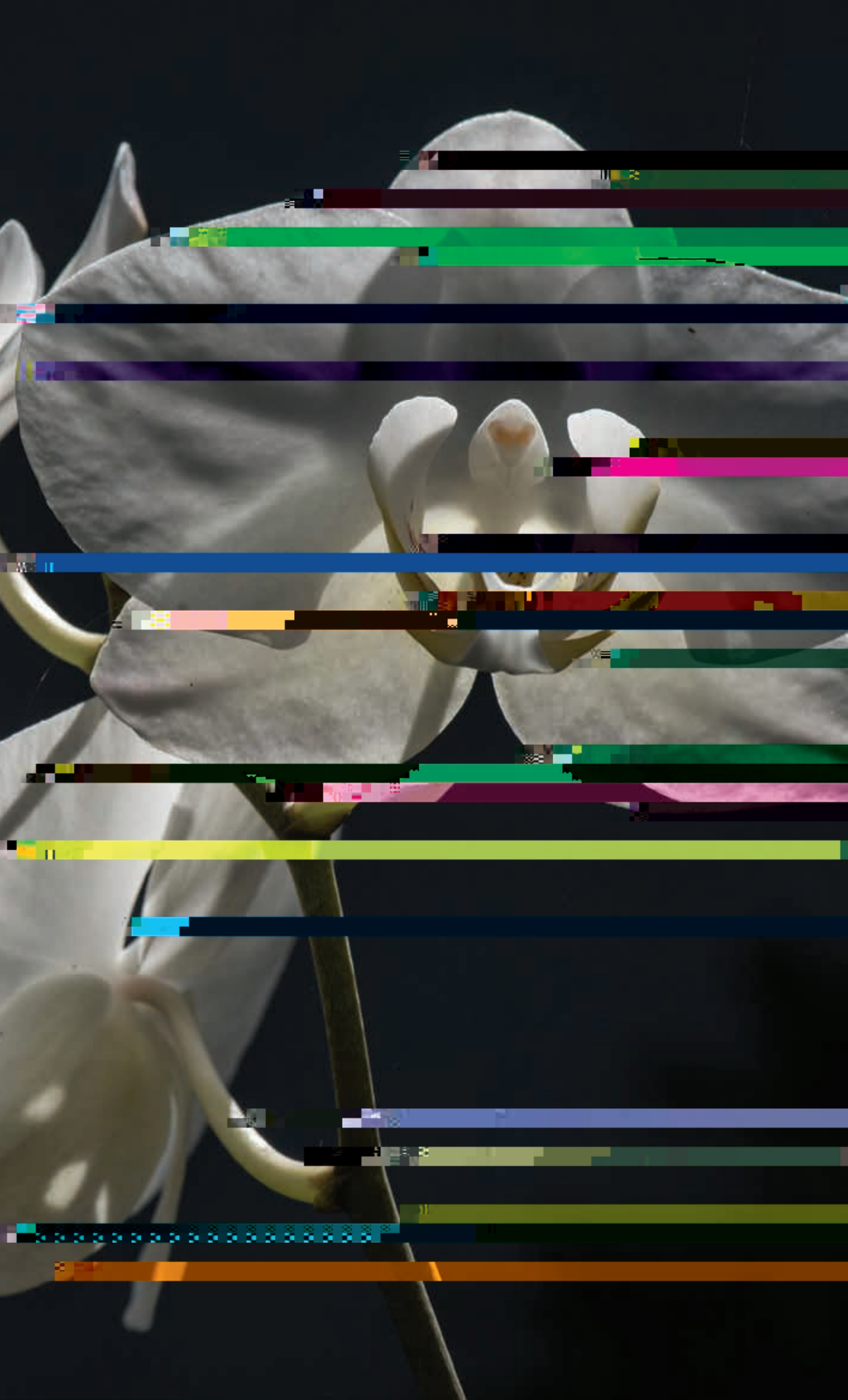


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