Newsletter

Australasian Systematic Botany Society

No. 185, December 2020

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Australasian Systematic Botany Society (ASBS)

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In this issue

From the President

Dan Murphy

Retiring ASBS President Dan Murphy. Photo: Royal Botanic Gardens Victoria

You will see from my annual President's report at the recent AGM (see p. 10) that I am writing this just as Victoria is exiting the second major COVID-19 lock-down. Despite the challenges of 2020, I have loved my time working on the ASBS Council, and the past six years have flown by; however, I am, like most, looking forward to seeing the end of 2020 and hopefully a 2021 which returns to some normalcy. This will not be the case for the annual ASBS conference yet, as we have just heard from the Cairns conference organisers (see Katharina Nargar's report p. 4) that the 2021 conference will have to be held online. This is completely understandable and the ASBS Council fully supports this decision for the reasons Katharina outlined at the AGM. After being involved in my first electronic AGM, I can also see how meetings can be successfully held online and I am looking forward to the ASBS conference, even if I feel a sad about not being able to visit Cairns and meet all our ASBS members in person.

As I finish my term as ASBS President, Darren Crayn's advice comes to mind, as he handed over the President's mantle, he told me that he thought it was inevitable that we feel we leave the role with unfinished business. I feel this acutely this year, but I know each Council picks up the baton from the previous one and runs with certain ideas and projects. I wish Mike Bayly, our new President, and the 2021 ASBS Council every success. Each Council I have been involved in, and I am sure since the society started, oversees implementation of incremental changes. My major interest has tended to be in the society's support for systematics research, and I am glad to be leaving Council at a time when our Research Funds are running smoothly and are sought after by our membership (as demonstrated by the numerous highly competitive applications). This, of course, has been facilitated by our very organised Vice-President, Heidi Meudt, and a long-standing dedicated Research Committee (see p. 28 for the committee members and Heidi's Research Report). On behalf of the Society, I thank Heidi Meudt, as Chair of the Research Committee, and all the other members of our ASBS Research Committee for their hard work. Recently, the ASBS has been funded to provide a new Student Travel grants scheme to provide students with support to attend conferences and workshops in Australia and overseas, which will fill a current gap in available funding. Above all, I am very proud to have held the ASBS President's role and wish the incoming Council all success, and I will continue to be an enthusiastic fan of our wonderful Society.

Recent ASBS Eichler funding news

Heidi Meudt

ASBS Vice-President and Chair, *ex officio* of the ASBS Research Committee

Hansjörg Eichler Grant September 2020 winners

This round we had a whopping 6 applications for the Hansjörg Eichler Scientific Research Fund, from a wide variety of ASBS members and for an interesting mix of projects. The applications were also of high quality, and the ASBS Research Committee had the difficult task of selecting two to fund this round. The two applicants who were successful this round are:

Sophie Newmarch, MSc student, Massey University, $5,000 for the research project, "Origin and diversification of *Libertia* (Iridaceae)". Primary supervisor: Assoc Prof Jennifer Tate.

Duncan Nicol, PhD student, University of Otago, $5,000 for the research project, "The evolution and biogeography of the subtribe *Celmisiinae* and the *Celmisia* subgenus *Lignosae*". Primary supervisor: Dr Matthew Larcombe.

Marlies Eichler Postdoctoral Fellowship July 2020 winner

Rachael Fowler, Postdoctoral Research Fellow, The University of Melbourne (June 2020 - Jan 2023), $10,000 per annum for 24 months for the project, "Exploration of the *Eremophila glabra* complex".

Congratulations to these three winners! The deadline for the next round of the Hansjörg Eichler Scientific Fund is 14 March 2021, and I encourage those who were unsuccessful in the September 2020 round, as well as any other ASBS members, to apply. Details here: http://www.asbs.org.au/asbs/hesrfund/index.html

ASBS conference 2021 goes virtual

Katharina Nargar, Darren Crayn, Ashley Field, John Clarkson & Frank Zich

ASBS 2021 Organising Committee

In response to the continuing uncertainties that the COVID-19 pandemic poses to the organisation and hosting of a face-to-face meeting mid next year, the ASBS conference organising committee has decided to hold the 2021 ASBS conference as a fully virtual meeting.

We considered that COVID-19 related travel restrictions and/or budgetary constraints remain highly likely to impact participation in a face-to-face meeting. Therefore, a virtual conference was regarded as the most inclusive option which facilitates the broadest participation, including from international society members and from our undergraduate and postgraduate students.

The highly dynamic situation caused by the pandemic also presented challenges for the planning of the logistics of a face-to-face meeting in many ways, for example through changes in availability of conference venues. The university lecture theatre became unavailable for the conference through James Cook University's change from a semester to trimester structure to enable social distancing during the teaching period and the venue which was originally booked for the conference dinner was unable take future bookings and is likely to remain closed.

On the bright side, the organising committee expects that registration fees for a virtual ASBS conference 2021 will be considerably lower than that of a face-to-face meeting, further facilitating broad participation. We are currently looking into options for web-based platforms with tools to enable a highly interactive and stimulating virtual conference.

Further updates will be provided in the next ASBS newsletter as well as on the ASBS 2021 conference website (https://systematics.ourplants.org/). Please feel free to contact the organising committee by email if you have any queries or comments: asbs2020Cairns@gmail.com.

Subscriptions for ASBS membership due

John Clarkson ASBS Treasurer

Subscriptions for ASBS membership are due on 1 January each year. Subscription rates for 2021 remain unchanged at:

- Ordinary/Institutional members (Full fee) AU$ 45.00
- Bona fide Full-time student / Retired / Unemployed members (Concessional fee) AU$ 25.00

Renewal forms are available on the ASBS web page at: http://www.asbs.org.au/asbs/membership.html

I will be sending a reminder notice by email before the end of the year. If you don't receive this, please get in touch with me. It probably means that I have an out of date email address.

Genomics for Australian Plants consortium update

Olly Berry – Environomics Future Science Platform, CSIRO

Darren Crayn GAP Phylogenomics Lead – Australian Tropical Herbarium and James Cook University

Mabel Lum GAP Project Manager – Bioplatforms Australia

David Cantrill GAP Lead – Royal Botanic Gardens Victoria

www.genomicsforaustralianplants.com @PlantsAus

The GAP Initiative is developing genomic resources and expertise to enhance our understanding of the evolution of Australia's unique flora and support its management. GAP was initiated by Bioplatforms Australia in partnership with the Australian state and national herbaria and botanic gardens. GAP has three project streams: reference genomes, phylogenomics, and conservation genomics, and also offers training resources. Here, we present an update on progress in each of these streams since August 2020.

Update list

1. Reference genomes:
   a. pilot phase
   b. second phase
2. Phylogenomics
3. Conservation genomics
4. Training

Reference genomes

Characterising plant genomes is challenging because of their large size and high repeat content. The reference genome pilot projects were designed to identify best practise for assembling the genomes of Australian plants. The consortium aims to create genomic resources where there are currently gaps in the tree of life so that researchers have access to high-quality assemblies to aid new research projects.

In phase two these principles will be applied to generate high-quality genome assemblies for a broader suite of Australian taxa. Reference genomes are valuable framework datasets that enable a range of applications, including discovery of new crops, conservation, and retracing the evolutionary history of Australian plants.

Reference genomes pilot phase

Acacia pycnantha

Team leader Dan Murphy, Royal Botanic Gardens, Victoria

The team continues to improve the draft assemblies of the nuclear, chloroplast and mitochondrial genomes of Australia's floral emblem. Transcriptomic data are being used to improve the assembly for this ecologically and economically significant species. The team is working on a draft manuscript.

Telopea speciosissima

Team leader Jason Bragg, Royal Botanic Gardens, Sydney

The remarkable re-growth of the living voucher specimen thought lost in the early 2020 bushfires has been a bonus for the project since it means material should be available for future research. Having completed 10X and Promethion long-read assemblies the team has now generated Hi-C data, which will be used to improve the assembly. The team will begin working on a manuscript shortly.

Reference genomes second phase

The GAP consortium received a large number of high-quality expressions of interest and will support the assembly of genomes for the seven taxa listed below. Project agreements have been established for all taxa, and voucher plants will be selected and DNA extracted within the next few months for most species (dependent on availability and growth).

Solanum centrale (bush tomato, kutjera)
Team leader: Heidi Nistelberger (Department of Biodiversity, Conservation and Attractions, WA)

Eremophila drummondii (Drummond's eremophila)
Team leader: Rachael Fowler (University of Melbourne)

Thelymitra variegata (Queen of Sheba orchid)
Team leader: Katharina Nargar (CSIRO, Australian Tropical Herbarium)

Leucochrysum albicans (hoary sunray)
Team leader: Alexander Schmidt-Lebuhn (CSIRO)

Wahlenbergia ceracea (waxy bluebell)
Team leader: Jemimah Hamilton (ANU)

Phebalium stellatum
Team leader: Jeremy Bruhl (University of New England)

Xanthorrhoea australis (southern grass tree)
Team leader: Todd McLay (Royal Botanic Gardens Victoria/University of Melbourne)

Reference genomes: database of plant genomes

David Cantrill, Graham King and Darren Crayn with the support of the plant science community have created a database documenting existing and developing assembled genome resources for plants. They have also undertaken a phylogenetic gap analysis to identify under-represented groups in the plant tree of life that could be the target of future projects. GAP encourages the plant science community to use and to actively update this resource, which can be found here.

Phylogenomics (Australian Angiosperm Tree of Life (AAToL))

In stage one, the project aims to generate DNA sequences of c. 350 nuclear genes from a representative of more than 95% of the nearly 2100 native Australian angiosperm genera. Collaboration with Royal Botanic Gardens Kew's PAFTOL project will deliver data for over 400 of these. Nearly half of all AAToL samples have been submitted to AGRF for processing. Of these, samples from the WA and SA teams have progressed furthest, having completed the target capture step. Samples from the NSW and QLD/NT teams have completed initial quality control. Collation of samples from Victoria has been delayed by COVID-19 restrictions.

As indicated in the last newsletter the program is on track to achieve a target of 95% of Australian angiosperm genera. Publication plans are being developed both for the AAToL data alone, and for combined AAToL-PAFTOL datasets. Stage 2 of the AAToL project will sample intensively within clades of interest to the research community, as determined by an EoI process similar to that run for the GAP reference genomes and conservation genomics streams. It is anticipated the EoI process will launch in the first half of 2021, once the outcomes of stage 1 (in terms of sequencing success) are known.

The phylogenomics working group continues to meet regularly with the PAFTOL team to manage and develop collaboration between the two significant and aligned programs. Collaboration with the New Zealand community is also being developed principally through Peter Heenan (CHR) and Jen Tate (Massey University).

AAToL researcher directory

To encourage collaboration we have published on the GAP website a directory of researchers participating the phylogenomics stream and more broadly working in plant phylogenomics. We encourage anybody who would like to be listed in the directory to contact Mabel (mlum@bioplatforms.com) or Darren (darren.crayn@jcu.edu.au).

Conservation Genomics

The Conservation Genomics project stream supports research into angiosperm species complexes requiring taxonomic resolution and containing potentially at-risk taxa. Fifteen species complexes were selected (see last newsletter) and projects have been initiated. GAP is primarily supporting SNP genotyping for the selected taxa, and it is anticipated that the majority of samples will be submitted by July 2021.

Training

We continue to add content to the genomics training page. As always, we welcome your contributions and suggestions. The genomics workshop which was to be presented at the cancelled 2020 ASBS meeting will benefit from extra time now available to develop an even better workshop for the 2021 meeting.

Anna Syme, the dynamic leader of our training program and important contributor to the reference genomes project, has moved to a new position at the Australian BioCommons and Melbourne Bioinformatics. Congratulations Anna and thank you for your excellent contributions to GAP! Applications to fill Anna's position closed last week.

Acknowledgements

We gratefully acknowledge the support of the Ian Potter Foundation, the Royal Botanic Gardens Victoria Foundation, and the many institutions and researchers that have committed cash and in-kind support to the GAP initiative.

Australasian Systematic Botany Society Inc. 42nd Annual General Meeting

18th November 2020, Zoom videoconference

Minutes

Hervé Sauquet ASBS Secretary

Australasian Systematic Botany Society Inc.
42nd Annual General Meeting
Zoom videoconference
At 13.02-15.00 Australian Eastern Daylight Time (AEDT), 18 November 2020.

Council present: Dan Murphy (President), Heidi Meudt (Vice-President), John Clarkson (Treasurer), Hervé Sauquet (Secretary), Ryonen Butcher (Councillor), Katharina Nargar (Councillor), Mike Bayly (incoming President).

A total of 60 participants attended the meeting (including 55 members who signed in via the chat or an email sent after the meeting).

Meeting opened at 13.02 AEDT [with 49 participants].

Welcome and apologies: DM welcomed everyone to the first electronic AGM of our Society. Apologies noted: Kelly Shepherd, Stephen Bell, David Cantrill, Michelle Waycott, Melodina Fabillo, Jessie Prebble.

Keynote presentation: Dr Joyce Chery, Assistant Professor at Cornell University, gave a short keynote presentation on "How to build a vine: a multiscale approach" (invited by Hervé Sauquet).

Update on Taxonomy Australia: Dr Kevin Thiele, Director of Taxonomy Australia, gave a brief update on recent activities of Taxonomy Australia (invited by Dan Murphy). In particular, Kevin Thiele summarised the main discussions of a recent National Taxonomy Leaders' Meeting held online on 20 October 2020 (all members of the current ASBS Council had been invited).

Recording of the videoconference started at this point, for internal purpose only. No objections were made. The video will be available to financial members on request from the

Secretary for three months upon publication of this newsletter, then deleted permanently.

Minutes of the previous AGM were published in the ASBS Newsletter no. 181 (December 2019, pp. 10-12). No objections. Darren Crayn moved, Ryonen Butcher seconded.

Reports:

- *President's report* (presented by Dan Murphy): see p. 10 of this newsletter.
- *Treasurer's report* (presented by John Clarkson): see p. 12 of this newsletter. No questions were asked. Karen Wilson moved, Tanya Scharaschkin seconded.
- *Newsletter report* (presented by Lizzy Joyce): see p. 26 of this newsletter.
- *Webmaster's report* (presented by Anna Monro): see p. 27 of this newsletter.
- *Facebook report* (presented by Mike Bayly): see p. 27 of this newsletter.
- *Research Committee report* (presented by Heidi Meudt): see p. 28 of this newsletter.

Update on next ASBS Conference: Katharina Nargar spoke on behalf of the organising committee: see p. 4 of this newsletter.

New ASBS Council: Dan Murphy presented the new ASBS Council for 2020-2021. Each position was filled by a single nomination, except for the two Councillor roles for which three nominations were received and an election held.

- Mike Bayly – President
- Heidi Meudt – Vice-President
- John Clarkson – Treasurer
- Hervé Sauquet – Secretary
- Katharina Nargar – Councillor
- Kelly Shepherd – Councillor

Mike Bayly and Kelly Shepherd are joining Council (both with previous service experience), while Dan Murphy and Ryonen Butcher are stepping off. DM thanked Ryonen Butcher for her service and enthusiastic energy as Councillor. On behalf of Council, HS thanked DM for his leadership and guidance as President.

General business: Darren Crayn asked a question about investment of funds into ethical companies. A short discussion followed (Kevin Thiele, Dan Murphy, John Clarkson). Consensus emerged that this is an important question for the Society, which Council will review over the coming year.

Meeting closed at 15.00 AEDT [with 50 participants].

Minutes: Hervé Sauquet (Secretary).

President's report

Dan Murphy ASBS President

This is my second AGM President's report to the ASBS membership and I am writing this while Victoria exits the second major COVID-19 lock-down. Like most organisations and events this year, Council business has all been conducted in a virtual format, with Zoom meetings, and voluminous communications via email. I thank all members of our 2020 Council for their patience and for being so responsive and dedicated to their roles. This has been essential this year to keep ASBS business running smoothly. Our thanks at this point must go to Hervé Sauquet as the Secretary, as this normally busy role has become even busier. He has arranged the society's business, meetings, and an election very effectively and with enthusiasm via the online formats.

Finances and membership

For the AGM I believe the most important questions from the membership to Council are usually about the finances of the society. We thank John Clarkson for his dedication and the experience he brings to the role of Treasurer, and as you will see in his 2020 Treasurer's report, he has gone above and beyond again, and has even managed to seek out additional funds that are owed to the society by the Australian Tax Office for franking credits on previous years' investments. John has also been actively chasing membership subscriptions for those of us who have fallen behind in payment, and is working out exactly what a printed newsletter costs to produce per member. Most importantly, as you will see, the status of the Society's finances remains very healthy. Despite 2020 being so volatile for investment markets, both the General and Research Funds have returned surpluses. It is reflective of the 'conservative' investment strategy that the whole of Council took a few years ago. This is the type of year when a conservative investment strategy helps ride out market volatility, and avoids the need to draw on investments when the market is depressed to fund our normal society activities, such as our annual research funding. We have weathered the storm very well this year.

Membership

We currently count our membership at 309, which at first glance is down approximately 10% on the figure we had last year. However, as you will see explained in the Treasurer's report a number of members who have remained unfinancial for more than 2 years were marked as inactive. In addition, we would normally expect an annual influx of members, especially students, around the time of our conference and we have missed out on this in 2020. This influx may occur for the 2021 electronic conference, but time will tell if that occurs or whether we might get a bounce in membership once we next hold a face-to-face conference (hopefully in 2022!).

Communications: new Newsletter look and editors and website transition

It has been great to see the directions our new editorial team have taken the newsletter in this year. The change in format and plenty of content have built on the wonderful legacy of the previous editors and remains a great strength of the Society. Printing the newsletter does come at a cost for the society. Council has resolved to implement a surcharge from the 2022 membership year if newsletters remain in hardcopy. On behalf of the Society we thank our newsletter editors, Lizzy Joyce and Alex George, as well as Todd McLay (news items) and John Clarkson (book reviews).

Council has recognised for some time now that the current ASBS website is not meeting all of the Society's needs and requires renewal and re-design, and after a small push, the hosting arrangements also need to be changed after many years of being generously supported by ANBG. Therefore,

Council has recently resolved to take the opportunity, while migrating to a new host and platform to have a re-design of the webpage (via external providers). Anna Monro has offered to continue her long association as webmaster. We are very grateful for her continued dedication and going above and beyond in updating and careful checking of our web content. This website project will be undertaken during the coming year and is planned to be a Councillor-led initiative, with Council input and full support.

New ASBS Council

Congratulations to our 2021 ASBS Council, which is as follows: Mike Bayly – President, Heidi Meudt – Vice-President, John Clarkson – Treasurer, Hervé Sauquet – Secretary, Katharina Nargar – Councillor, and Kelly Shepherd – Councillor.

I welcome our new Council, and especially our two new members. We welcome back Mike Bayly as President, I think the only role he has not held previously. I know directly of his long-standing and unwavering support for the Society. We also welcome back Kelly Shepherd, who is similarly dedicated and highly supportive of ASBS, always asking after how things are going for ASBS whenever we meet. I think this new council is the perfect mix of continuity, experience and changing of roles. On behalf of all our members I would like to thank Ryonen Butcher, who is stepping down from Council this year, for all her work, and especially her humour and enthusiasm!

This year we held an election for the Councillor roles, which is always a very positive indication that being on Council is sought after and is seen to be a way to effectively contribute to our science. Thanks to all who voted and especially to our three candidates and Hervé Sauquet, who as secretary, ran a very successful and smooth election process online.

Future directions: Representation, some rule changes and Student Travel Grants

As we hope to be a Society of maximal inclusiveness, the Council has recently started developing two subcommittees to assist with this. One subcommittee will look at matters of diversity, in order to increase inclusion and broaden representation of the ASBS, as well as inform council on matters of diversity and inclusiveness, and help us highlight any potential blind-spots to increasing the diversity of the society. Council acknowledges there are areas of under-representation of our membership-base, and in particular our geographical coverage (in Australasia). The other subcommittee is intended to increase student participation in ASBS governance, with an aim to inform Council of matters of importance to students, and to recognise at early stages any potential issues or concerns arising that may relate to students.

As you may have seen in the September 2020 *ASBS Newsletter* (p. 12-13), John Clarkson has flagged that now is a good time to investigate some rule changes for the Society, and as these changes require a vote of our membership it is much more efficient to 'save-up' rules changes to undertake one vote rather than do this multiple times. The changes relate to allowing the Society to hold electronic AGMs. This year's meeting was held under a special COVID-related provision of the ACT Registrar General, but we can see the many advantages of having the option of running electronic AGMs in the future. We have also discussed how we may update the ASBS logo, and there are several Incorporation governance amendments brought about by changes to the ACT Associations Incorporation Act that may require rule changes. Watch this space for the upcoming requirements as these are developed by Council.

This year we have signed an agreement to manage what was previously the ABRS student travel grants scheme (at least the botanical side). Council feels this is an excellent scheme to implement as it fills a direct need of an important group of our members. This scheme will have its own selection criteria which are to be implemented in the coming months, as obviously not a lot of travel has

been happening this year. We note there may be some delay until travel is more routine again. A new grant scheme adds somewhat to the workload of our Vice-President, Heidi Meudt, and the Research Committee. This year Council noted and thanked Heidi for the outstanding work that she has been undertaking in politely, but firmly, following up reporting requirements from past awardees of various ASBS-funded research projects, we also thank the Research Committee for the assessment of a large number of research funding applications.

Annual General Meeting

At this time of the year the ASBS AGM is a major focus for Council and this year the imperative of moving to a virtual meeting has meant a different lead up to the meeting from Council, but has also given us the bonus of being able to try new things. Hervé invited Dr Joyce Chery (Cornell University), who gave a wonderfully interesting scientific talk, and we thank Joyce very much for this. Many thanks are also due to our members for the healthy turn-out to attend the AGM. By all accounts it was successful (as we have received much excellent feedback). I was somewhat nervous prior to the meeting about how many would attend an electronic AGM, so I was very happy with the final attendance numbers!

We congratulate our 2020 Nancy Burbidge medallist, Dr Wendy Nelson (see *ASBS Newsletter* no. 184, p. 4 for more details). Although we did not have a Burbidge Lecture this year, as we were holding out in case it was possible to invite the Nancy Burbidge medallist to attend the 2021 ASBS conference in person, we will now invite Wendy to give her Burbidge Lecture as an electronic presentation associated with the 2021 ASBS conference.

Finally, although my six-year term on Council comes to an end, and it has been a busy time, I have found it to be a wonderful experience. I encourage anyone interested in taking part in the Council to do so. Each Council I have been on has been quite different, but has shared in a real team spirit. In previous years, this has culminated in an exciting, busy and fun ASBS conference. However, I must say that even without the conference to build the Council year around, this year's Council has felt like a very cohesive team. Although I hope we may return to face-to-face conferences soon, I do note that there are some positives to becoming more accommodating of virtual meetings. However, it is my strong wish that coming generations of students and early career researchers, as well as more experienced botanists, can continue to share in the experience of 'live' ASBS conferences, and see 'real' plants on the associated field-trips. Seeing new plants and being with our colleagues in the field cannot be fully replaced by anything on a screen!

Treasurer's report 2019/20

John Clarkson ASBS Treasurer

1. Introduction

I am pleased to present the financial statements of the Australasian Systematic Botany Society Inc. (ASBS) for the year ended 30 June 2020 (Appendix 1). The finances of the Society are run on a financial year basis with data reported on a full cash basis.

Philippa E. Whitting of McKinnon & Co. Atherton audited the accounts. Her report to members follows as Appendix 2.

2. Membership

Table 1 summarises the number of members at the end of October 2020. Since the last report, 8 new members have been admitted to the Society, 11 members have resigned and one long time member, Helen Aston,

died. In 'normal' years a few applications for membership are received just before the annual conference. Not surprisingly, with the conference having to be postponed because of the COVID-19 pandemic, this year has been an exception and only one application for membership (a student) has been received since the end of the financial year.

It is not uncommon in this report for the Treasurer to draw attention to the chronic problem associated with late payment of subscriptions and the high number of unfinancial members. Annual subscriptions are due on January 1, but 79 members remained in arrears just prior to the 2019 AGM. This year is no exception. By the end of March we were on track for a similar situation. 147 members had not responded to several reminders that annual subscriptions were due. There is provision in the Society's Rules (Rule 5) for dealing with members who remain unfinancial for more than two consecutive years. With the assistance of Local Conveners, a concerted effort was made to contact unfinancial members who fell into this category. I'm pleased to report that the numbers are much improved, and the membership database now better reflects the active membership. Of the 147 we attempted to contact, 43 either did not respond or were uncontactable by email, 95 paid and 9 resigned. The 'missing 43' were marked as inactive but are free to reapply for membership at any time.

Table 1 Membership of ASBS as of 1st November 2020 (non-financial members in brackets).

Fee	Full	Concessional	Gratis	Total
Ordinary	183 (10)	n/a	0	183 (10)
Student	n/a	39 (5)	0	39 (5)
Retiree	n/a	59 (1)	0	59 (1)
Unemployed	n/a	6(1)	0	6 (1)
Institutional	5 (1)	n/a	14	19 (1)
Life	n/a	n/a	3	3
Total	188 (11)	104 (7)	17	309 (18)

The following new members have been admitted to the Society since the last AGM:

Paulo Cesar Baleeiro Souza	BRISBANE, QLD, Brisbane
Patricia Chan	MADISON, USA, Overseas
David Glenny	LINCOLN, NZ, South Island
Frances Guard	BALMORAL RIDGE, QLD, Brisbane
Duncan Nicol	NORTH EAST VALLEY, NZ, Christchurch
Julia Percy-Bower	KENSINGTON, WA, Perth
Aiden Webb	BRUNSWICK, VIC, Melbourne
Luis Williamson	MITCHELL PARK, SA, Adelaide

3. Management of Funds

3.1. General Fund

The General Fund finished the financial year with a surplus of $5,139, a pleasing turnaround from the previous year's $12,574 deficit. There is perhaps only one item of note in the General Fund income and expenditure that warrants discussion. The Society has entered into an agreement with the Australian Biological Resources Study (ABRS) to administer a small grant scheme aimed at providing financial assistance to postgraduate students to attend Australian or international conferences and workshops relevant to the field of taxonomy and systematics. The funds available total $16,500 over two years and the figure of $8,250 recorded as ABRS Student Travel Grant is the first year's instalment. Details of when and how the grant will be offered are on hold pending a relaxation of the COVID-19 travel restrictions.

All assets in the General Fund are still held as either cash at call or in reasonably short (6-9 months) term deposits. A small amount required for day-to-day needs is held in a cheque account with the Commonwealth Bank. This account does not pay interest. To secure income on surplus funds, most of the money in the General Fund is split between a high interest earning account and two term

deposits with Rabobank. Like most financial institutions, interest payable on funds in the Rabobank accounts has been falling steadily over recent years. The high interest account now attracts only 0.25% and the term deposits 1.0% and 0.9%. Five years ago, the high interest saving account was earning 2.05%, and 5 years before that 5.1%. When the term deposits were set up in late 2017 they paid 2.5%. These falling interest rates are reflected in the 5-years averages for investment income. The most recent 5-year average (14/15 to 18/19 financial years inclusive) was $4,110 compared with an average of $5,565 for the 5 years before that. Investment income for the 2019/20 financial year was only $2,535.

Membership fees have not been increased since 2005. The 5-year running average for income derived from subscriptions in that period has remained steady at just over $10,250 per annum. This year's figure of $12,675 includes subscriptions from 28 members who took up the offer to pay for a few years in advance, so this slight increase may be matched by a lower income from this source in 2020/21. I am loath to recommend an increase in membership fees while the Society is well placed financially, has reported a surplus in all but 2 years since 2005, and has no plans for any major increase in expenditure in the foreseeable future.

There is, however, an issue with subscriptions for members who receive the *ASBS Newsletter* in hard copy. The cost of printing and posting each issue of the *Newsletter* depends on the number of pages. Costs for the last 2 issues have totalled $1,555 suggesting the annual cost for 4 issues will be somewhere around $3,000. Of 309 active members, only 66 (21%) fee paying members opt to receive the *Newsletter* in hard copy. 27 of these are eligible for the concessional membership fee of $25 and 39 pay the full $45 fee. Copies are distributed free of charge to State herbaria in Australia and New Zealand and the Royal Botanic Gardens Kew. Membership fees from members receiving the *Newsletter* in hard copy total $2,430, roughly $600 less than the cost of printing and posting 4 issues each year. In effect, members who opt to receive the *Newsletter* in hard copy are being subsidised by those who do not. There are two ways of dealing with this. Production of the *Newsletter* in hard copy could be discontinued. Previous Councils have considered this but there has always been a reasonable interest, particularly from long-term members, in retaining the hard copy and Council is reluctant to stop production at this stage. Raising the membership fees would only further disadvantage members who take only the electronic version, but introducing a surcharge for those opting to take the hard copy could provide a fair and equitable solution. Council has resolved to leave things unchanged for next year and impose the surcharge from the 2022 membership year.

3.2. Research Fund

The Society continues to offer up to $40,000 each financial year to support research projects in plant systematics. Projects supported include Hansjörg Eichler Research Grants and the Marlies Eichler Postdoctoral Fellowships. Grants for the 2019/20 financial year totalled $39,808. The COVID-19 pandemic has had a profound effect on global financial markets, but the effects in Australia were not realised until late February to early March and the Research Fund ended the financial year with a $30,583 surplus. Markets have deteriorated since, but the Society is hopeful of weathering the downturn and emerging in a reasonably strong position. The investment in the Colonial managed fund sustained an unrealised capital loss of $48,073 for the financial year but this is not unexpected. The ColonialChoice Wholesale fund is a conservative fund with 70% of investments allocated to defensive assets such as fixed interest and cash. The unit value has been significantly affected by the current financial crisis (Figure 1). The Society was able to avoid realising this loss by funding the 2020 Research Grant Program and the Marlies Eichler Fellowships from cash reserves. Sufficient cash remains to fund the first round of Eichler Grants in 2021. It will not be necessary to draw on the Colonial investments until October 2021 by

which time the unit value will hopefully have recovered. Units began the financial year valued at $1.0442 and rose steadily to a high of $1.0802 in late February before falling sharply to $0.9624 in less than a month as the financial effects of the pandemic spread to Australian markets. They finished the financial year at $1.0296. The value has recovered somewhat since then to a high of $1.0113 in mid-October. The value at the end of October was $1.0013. The Society holds just under 1.173 million units so you can appreciate how even a small fluctuation in the unit value can affect the value of the portfolio. The falling unit value has been partly offset by profit distributions from the 30% of the portfolio allocated to growth assets such as shares, property and infrastructure securities, and to management fund rebates. These are reinvested as they are received. 69,568 units were purchased in the financial year and a further 4,011 units in September (Figure 2). The Colonial investment portfolio was valued at $1,174,127 at the end of October.

Figure 1 Change in unit value (AU$) from 1 July 2019 to 31 October 2020.

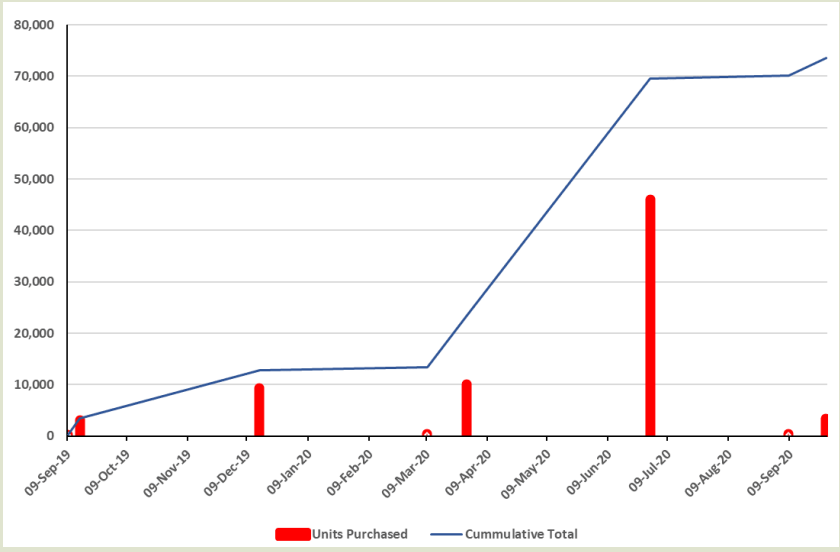

Figure 2 Increase in unit holdings since 1 July 2019.

This financial year, 68 members made donations to the Hansjörg Eichler Research Fund totalling $8,985. All donors, including the following members who agreed to having their names recorded publicly, are thanked for their generous support:

Helen Aston
Paulo Cesar Baleeiro Souza
Michael Bayly
Frank Bedon
Chris Betteridge
Joanne Birch
Margaret Brookes
Jeremy Bruhl
Christine Cargill
John Clarkson
Darren Crayn
Murray Fagg
Robert Gibson
Laurie Haegi
Frank Hemmings
Alison Hewitt
Roger Hnatiuk
Gareth Holmes
John Hosking
Betsy Jackes
Laurie Jessup
Richard Jobson
Bronwen Keighery
Greg Keighery
Pauline Ladiges
Teresa Lebel
Terry Macfarlane
Sarah Mathews
Merran Matthews
Bill McDonald
Dirk McNicoll
David Meagher
Yolanda Metti
Peter Michael
Pina Milne
Andrew Mitchell
Daniel Murphy
Maggie Nightingale
David Orlovich
Ruth Palsson
Caroline Pannell
Matt Renner
Carolyn Sandercoe
Kelly Shepherd
Philip Short
Ian Telford
Kevin Thiele
Nanette Thomas
Stephen van Leeuwen
Helen Vonow
John Walker
Barbara Waterhouse
Juliet Wege
Judy West
Molly Whalen
Annabel Wheeler
Karen Wilson
Peter Wilson
Nicholas Yee

Having secured registration as a charity with the Australian Charities and Not-for-profit Commission, the Society applied to the Australian Taxation Office for a refund of franking credits dating back to the 2003/04 financial year. A refund of $9,325 was received in August, too late to include in this financial year's report. A further $8,344 has still to be received.

4. Summary

To finish the year with surpluses in both the General and Research Fund in such difficult financial times is a pleasing outcome. To achieve a similar outcome in the 2020/21 financial year will be a challenge but one Council will work hard to achieve.

In July 2019, the ACT government enacted the *Red Tape Reduction Legislation Amendment Bill 2018*. This has led to changes to the *Associations Incorporation Act 1991* and the *Associations Incorporation Regulation 1991*. Associations incorporated in the ACT may need to amend their Rules to ensure these changes are addressed. One of the amendments deals with the requirements for reviewing or auditing financial accounts. Associations are now classified as small, medium, or large depending on their annual revenue. With an annual revenue less than $400,000, ASBS is considered to be a small association and is no longer required to appoint an auditor. However, having been entrusted with 3 terms as ASBS Treasurer with responsibility for managing over $1.3 million in Society's funds, my recommendation would be to retain the requirement to appoint an auditor in the Society's Rules.

Appendix 1

Financial Report for the year ended 30 June 2020

Australasian Systematic Botany Society Incorporated
ABN 22092454279

2019-20 Financial Report

Council's Report

Your Council members submit the financial statement of the Australasian Systematic Botany Society Incorporated for the year ended 30 June 2020.

Council Members
The names of the Council members who held office throughout the reporting period and at the date of this report are:

President	Daniel Murphy	Elected March 2019
Vice President	Heidi Meudt	Elected March 2019
Secretary	Hervé Sanquet	Elected November 2019
Treasurer	John Clarkson	Elected March 2019
Councillor	Ryonen Butcher	Elected September 2016
Councillor	Katharina Nargar	Elected November 2019

Principal Activities
The principal activities of the society during the reporting period were to promote systematic botany in Australasia.

Significant Changes
No significant change in the nature of these activities occurred during the reporting period.

Operating Results
The operating results are as set out here under:

	Year ending June 2020	Year ending June 2019
General Fund	$5,138.94	($12,573.99)
Research Fund	$30,583.00	$65,654.78
Total	**$35,721.94**	**$53,080.79**

Signed in accordance with a resolution of the Members of the Council on:

Daniel Murphy (President)

18th November 2020

John Clarkson (Treasurer)

18th November 2020

Income and Expenditure Statement
Australasian Systematic Botany Society Incorporated
For the year ended 30 June 2020

	2020	2019
General Fund Income		
Cheque Account		
Conference	2,073.15	3,000.00
Copyright Agency	64.30	152.36
Donation to Eichler Fund	8,990.00	7,465.00
Subscriptions	12,675.00	14,972.22
ABRS Student Travel Grant	8,250.00	-
Sundry income	1,008.94	200.00
Conference Account		
Transfer from General Fund	3,000.00	-
Registration	-	26,490.00
Dinner	-	5,985.00
Workshop	-	2,910.00
Field trip	-	2,435.90
Sponsorship	-	1,700.00
Miscellaneous	-	130.00
Refund of deposits paid	815.00	-
Rabobank Accounts		
Investment income	2,535.79	3,522.96
Total General Fund Income	**39,412.18**	**68,963.44**
General Fund Expenses		
Cheque Account		
Council expenses	2,205.43	2,525.37
Auditor's remuneration	1,672.00	3,575.00
Australasian Plant Conservation Network	-	290.00
Bank charges, credit card fees	329.67	312.60
Postgraduate workshop sponsorship	2,500.00	2,500.00
Student travel assistance	1,728.00	1,500.00
Decadal plan/Taxonomy Australia	5,500.00	11,000.00
Miscellaneous expenses	1,425.82	-
Newsletter costs	1,699.49	1,887.74
Burbidge Medal	1,764.68	-
Transfers to Research Fund	11,058.15	14,042.76
Transfer to Conference Account	3,000.00	
Conference Account		
Conference	-	20,571.60
Workshop	-	2,236.00
Welcome reception	500.00	2,270.30
Dinner	815.00	2,610.65
Field trip	50.00	2,209.57
Bank charges, credit card fees	25.00	505.84
Refund ASBS seed funding	-	3,000.00
Transfer to Research Fund	-	10,500.00
Total General Fund Expenses	**34,273.24**	**81,537.43**
General Fund Surplus/(Deficit)	**5,138.94**	**(12,573.99)**

McKINNON & CO. ACCOUNTANTS PTY LTD CPA AUSTRALIA

2019-20 Financial Report

Research Fund Income		
Donations to Research Fund	8,985.00	9,410.00
Proceeds from Silent Auction	2,073.15	-
Investment Income – Colonial Wholesale Investment		
Distributions	68,808.40	62,279.14
Management Cost Rebates	860.40	292.78
Investment Income – Term Deposit	478.25	838.15
Transfer from General Fund	-	4,632.76
Profit from Brisbane Conference	-	10,500.00
Total Research Fund Income	**81,205.20**	**87,952.83**
Research Fund Expenses		
Bank Charges	-	40.27
Management Fees	10,814.20	10,135.31
Hj. Eichler Research Grants	19,970.00	5,030.00
Marlies Eichler Fellowships	19,838.00	19,586.00
Total Research Fund Expenses	**50,622.20**	**34,791.58**
Research Fund Surplus/Deficit	**30,583.00**	**53,161.25**
Current Year Surplus	**35,721.94**	**40,587.26**

2019-20 Financial Report

Balance Sheet
Australasian Systematic Botany Society Incorporated
As at 30 June 2020

	2020	2019
Assets		
General Fund		
Cash and Cash Equivalents		
General Fund: Cheque Account	18,837.43	18,659.28
General Fund: Rabobank HISA	10,155.35	20,017.72
Conference cheque account	2,646.94	221.94
Total Cash and Cash Equivalents	**31,639.72**	**38,898.94**
Investments		
Rabobank Term Deposit 1	63,239.41	51,955.49
Rabobank Term Deposit 2	53,005.07	51,890.83
Total Investments	**116,244.48**	**103,846.32**
Total General Fund	**147,884.20**	**142,745.26**
Research Fund		
Cash and Cash Equivalents		
Research Fund: Cheque Account	11,145.45	17,895.30
Total Cash and Cash Equivalents	**11,145.45**	**17,895.30**
Investments		
Colonial Wholesale Investment	1,155,853.27	1,145,072.26
Commonwealth Term Deposit	11,129.00	32,650.75
Total Investments	**1,166,982.27**	**1,177,723.01**
Total Research Fund	**1,178,127.72**	**1,195,618.31**
Total Assets	**1,326,011.92**	**1,338,363.57**
Member's Funds		
Accumulated Surplus	1,338,363.57	1,298,691.44
Current Year Earnings	35,721.94	40,587.26
Unrealised Capital Gain/Loss	(48,073.59)	(915.13)
Total Member's Funds	**1,326,011.92**	**1,338,363.57**

2019-20 Financial Report

Notes to the Financial Statements
Australasian Systematic Botany Society Incorporated
For the year ended 30 June 2020

1. Summary of Significant Accounting Policies

The financial report is a special purpose financial report prepared in order to satisfy the financial reporting requirements of the members. The Council has determined that the Society is not a reporting entity.

The financial report has been prepared in accordance with the requirements of Australian Accounting Standard AASB 1031: Materiality. No other applicable Accounting Standards, Australian Accounting Interpretations or other authoritative pronouncements of the Australian Accounting Standards Board have been applied.

The financial report has been prepared on a cash basis.

The following specific accounting policies, which are consistent with the previous period unless otherwise stated, have been adopted in the preparation of this financial report.

(a) Membership
Membership fees are recorded on a cash basis.

(b) Income Tax
Under present legislation the Society is exempt from income tax and accordingly no provision has been made in the accounts.

(c) Comparative Figures
Where required by Accounting Standards comparative figures have been adjusted to conform with the changes in presentation for the current year.

(d) Members Funds
In accordance with the rules of the Society, accumulated funds are not available for distribution to its members.

Research Committee

The Australasian Systematic Botany Society is an approved research institute.
The approved membership of the Research Committee comprises:

Daniel Murphy (Chair)	*Ex officio*
David Glenny	Appointed March 2013
Sarah Matthews	Appointed March 2015
Heidi Meudt	Appointed March 2016
Joanne Birch	Appointed March 2016
Katharina Schulte	Appointed March 2016
Murray Henwood	Appointed March 2016

Statement by the Members of the Council
Australasian Systematic Botany Society Incorporated
For the year ended 30 June 2020

The Council has determined that the Society is not a reporting entity and that this special purpose financial report should be prepared in accordance with the accounting policies outlined in Note 1 to the financial statements.

In the opinion of the Council:

1. The financial report as set out on pages 1 to 6 presents a true and fair view of the Society's financial position as at 30 June 2020 and its performance for the year ended on that date.

2. At the date of this statement, there are reasonable grounds to believe that the Society will be able to pay its debts as and when they fall due.

This statement is made in accordance with the resolution of the Council and is signed for and on behalf of the Council by:

President

Daniel Murphy – President

Treasurer

John Clarkson – Treasurer

Dated this 18th day of November 2020

Appendix 2

McKINNON & Co

CERTIFIED PRACTISING ACCOUNTANTS
ABN 65 010 329 576

McKinnon & Co Accountants Pty Ltd
1/11 Vernon Street, Atherton
PO Box 279, ATHERTON QLD 4883
Telephone (07) 4091 1244
Fax: (07) 4091 3202

Email: accountant@mckinnonandco.com.au
Web: www.mckinnonandco.com.au

INDEPENDENT AUDIT REPORT
TO THE MEMBERS OF AUSTRALASIAN SYSTEMATIC BOTANY SOCIETY INC.

Report on the audit of the financial report

Qualified Opinion

We have audited the accompanying financial report, being a special purpose financial report, of the Australasian Systematic Botany Society Inc. (the Association), which comprises the balance sheet as at 30 June 2020,the income statement & notes to the financial statements.

In our opinion, except for the possible effects of the matters described in the Basis for Qualified Opinion paragraph, the financial report of the Association presents fairly in all material respects in accordance with the *Associations Incorporation Act 1981* (as amended by the Associations Incorporation and Other Legislation Amendment Act 2007)

Basis for qualified opinion

Qualification- Segregation of duties

Such is the scope of the Association, it is not practical that internal controls can be constantly in place to provide a high degree of assurance that cash monies are fully accounted for. This qualification is not unusual for a small Incorporated Association.

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the auditor's responsibilities for the audit of the financial report section of our report. We are independent of the Association in accordance with the auditor independence requirements of the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110 Code of Ethics for Professional Accountants (the code) that are relevant to our audit of the financial report in Australia. We have also fulfilled our other ethical responsibilities in accordance with the code.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Emphasis of matter - basis of accounting

We draw attention to note 1 of the financial report, which describes the basis of accounting. The financial report is prepared to assist the Association to meet the requirements of the applicable legislation. As a result, the financial report may not be suitable for another purpose. Our report is intended solely for the Association and should not be distributed to or used by parties other than the association. Our opinion is not modified in respect of this matter.

Responsibility of management and those charged with governance

Management is responsible for the preparation and fair presentation of the financial report in accordance with the applicable legislation and for such internal control as management determines is necessary to enable the preparation of the financial report is free from material misstatement, whether due to fraud or error.
In preparing the financial report, management is responsible for assessing the association's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the association or to cease operations, or has no realistic alternative but to do so.

Those charged with governance are responsible for overseeing the association's financial reporting process.

Independence

In conducting our audit, we have complied with the independence requirements of Australian professional ethical pronouncements.

Auditor's responsibilities for the audit of the financial report

Our objectives are to obtain reasonable assurance about whether the financial report as a whole is free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the Australian Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of this financial report.

P. Whitting

Philippa E Whitting
Director

1, 11 Vernon Street, Atherton Q 4883

Dated 17 August 2020

Newsletter report

Lizzy Joyce ASBS Newsletter Editor

At the beginning of 2020 Bill and Robyn Barker stepped down as long-standing *ASBS Newsletter* Editors, and myself, Alex George, Todd McLay and John Clarkson took over the editorship in April. We presented the ASBS Council with three options for the *Newsletter* format going forward: an email-based electronic format, a website-based electronic newsletter, or to continue with the current printed version. After deliberation, ASBS Council advised us that they would like to continue with the printed version of the *ASBS Newsletter* as some members still prefer to receive it in hard-copy. To avoid the time, costs and environmental impact involved in producing a printed newsletter, ASBS Council has flagged that they are looking to transition to an electronic *Newsletter* in the coming years to mark the 50th Anniversary of the society.

The new editorial team has been working hard and efficiently, with Alex receiving articles and casting his editorial eagle-eyes over them, Todd compiling an interesting and pun-ny *News* section and John keeping up to date on recent book publications and organizing the book reviews. It's been absolutely fantastic working with these guys and I thank them very much for their time, work and support in developing the new format for the *ASBS Newsletter* and getting it across the line every quarter.

The members would notice that we have made quite a few changes, having refreshed the overall look of the *ASBS Newsletter*. However, we've stuck with tradition for the front page, which still features the current President's plant of choice as the front cover (stay tuned to see what incoming President Mike Bayly chooses for 2021!). We've made changes to content, reducing the number of *News* items to reflect that many members will now be receiving news through social media and online, instead opting to focus on topical articles, perspective pieces and updates from members, herbaria and systematics institutions. We have also shifted the printing to Cairns, and have developed a publishing schedule for the year in advance to aim for timely publication of the *ASBS Newsletter* each quarter.

This issue is the third *ASBS Newsletter* for 2020, and it's been fabulous to see the diverse range of content that has been published throughout the year. Each issue has seen the regular reports from the ASBS President and Treasurer, GAP, Taxonomy Australia, ABRS, Eichler Grant reports, the ASBS conference and the Hansjörg Eichler Funding Committee. In addition to these regular sections we've received articles on history, taxonomic practice, perspective pieces, teaching systematics, taxonomy, natural history and herbarium updates. Thank you to all members that have contributed. It has been great to see the *Newsletter* utilised as a platform for informal discussion of ideas and debate, especially in a time of rapid change for our field and society. Given the cancellation of the ASBS conference this year, and the separation of members due to the COVID-19 pandemic, I think the *Newsletter* has been particularly important in connecting members and communication in 2020.

In 2021 we look forward to continuing production of the *Newsletter* as usual. We aim to publish style guidelines and the publishing schedule on the ASBS website for reference for authors. In the lead up to the 50th Anniversary of the society, we also intend to feature articles from previous decades of the *ASBS Newsletter* (let us know if there are any in particular you want featured!). We also hope to see more regular updates from herbaria for our *Herbarium Happenings* section.

Finally, I would like to thank ASBS members and Council for their engagement and support with the *ASBS Newsletter* this year. We would particularly like to thank Robyn and Bill Barker for their guidance with the handover of the editorship, Anna Monro for getting us online every quarter, and Heidi Meudt for her very organised efforts in sending in content and catching us up on Eichler grant reports. As always, I encourage anyone with suggestions, feedback or contributions for the *ASBS Newsletter* to get in touch.

Webmaster's report

Anna Monro ASBS Webmaster

The Society's website continues to be maintained by Anna Monro and Murray Fagg, with content supplied by members of the ASBS Council and by the editors of the *Newsletter*.

In the last financial year the activities of the webmasters were largely "business as usual". Four issues of the *ASBS Newsletter* were uploaded (179, 180, 181, 182/183) as soon as possible after receipt and various routine updates were made to listings of job and training opportunities and award recipients. Server statistics show that the newsletter and research funds pages are among the most visited, with a spike in visits coinciding with the March 2020 round of Hansjörg Eichler grant applications.

For various reasons it is likely that the Society's web page will change in hosting arrangements over the next calendar year or so, moving to an independently-hosted site after a number of decades of online residence at the Australian National Botanic Gardens. This would offer several advantages, with the webmaster role no longer being tied to a single institution and making it easier to redesign the site in line with modern web standards and practices. If any members have expertise and interest in this area your thoughts would be valuable.

Finally, I'd like to sincerely thank Robyn and Bill Barker for their efficient editorship of the ASBS Newsletter over so many years and wish them a relaxing retirement from that role. The Barker tag-team production of the newsletter made the webmasters' job easy and as publication deadlines approached (and sometimes passed) we could always count on entertaining communications from Adelaide.

ASBS Facebook group report

Todd McLay & Mike Bayly ASBS Facebook Administrators

The ASBS Facebook group, now about seven and half years old, has grown from 1,125 members in November 2019 to 1,428 members in November 2020. The group is "public", which means anyone can see the group, members and posts, but only people in the group can post to the page.

There were 206 posts to the group in the year from 16 Nov 2019, soliciting 1419 "reactions" or comments from group members. Posts covered a variety of topics including news article relating to plants/environment/science in general, paper or book announcements, jobs and funding opportunities, herbarium news, death notices or obituaries, photos of plants, memes, and ASBS business, including announcements relating to conferences, newsletters, elections, membership payments, workshops etc. A great contribution this year came from Juliet Wege, regularly cross-promoting papers published as part of the 50 year anniversary of the Journal *Nuytsia*.

Requests to join the Facebook group are vetted by Mike Bayly or Todd McLay. We don't enforce any strict criteria on group membership, but aim to exclude obvious spammers and, due to a spike in membership requests from questionable Facebook accounts, we recently added a question for prospective group members to answer, i.e., "In 50 words or fewer - why are you interested in our society?". We are not too fussy about answers to that question, but wanted some level of filtering, and to quickly assess the motivations of applicants without manually examining all of their profiles.

In coming months we plan to re-vamp the cover image of the group, as well as on the society's Twitter feed, and we are likely to ask for image contributions from members.

The Facebook group is a great way for the dispersed members of our society to keep in touch and discuss our common interests. If you are on Facebook and haven't yet joined our group, you should!

Research Committee report

Heidi Meudt Chair, ex officio *of the ASBS Research Committee*

This was my second year as ASBS Vice-President and *ex officio* Chair of the ASBS Research Committee. A focus of mine in 2020 was to increase the number of reports submitted and published from previous Hansjörg and Marlies Eichler grant recipients. This year's published Hansjörg Eichler reports included:

Francis Nge, The University of Adelaide: 'Species delimitation in *Banksia* (Proteaceae)' (*ASBS Newsletter* 181, Dec. 2019).

Heather Merrylees, The University of Melbourne: 'The phylogeny and phylogeography of *Acacia myrtifolia* (Sm.) Willd. in southern Australia' (*ASBS Newsletter* 181, Dec. 2019).

Amelia-Grace Boxshall, The University of Melbourne: 'If it's yellow, let it mellow: investigating toxicity variation within southern Australian yellow-staining *Agaricus* L. in a phylogenetic context' (*ASBS Newsletter* 182-183, June 2020).

Lizzy Joyce, Australian Tropical Herbarium & James Cook University: 'Understanding the role of the Sunda Sahul floristic exchange in shaping Australia's northern flora' (*ASBS Newsletter* 182-183, June 2020).

One Marlies Eichler Postdoctoral Fellowship progress report was also published:

Dr Lars Nauheimer, Progress report on the project 'Phylogenomics and taxonomy of the donkey orchids (*Diuris*, Orchidaceae)' (*ASBS Newsletter* 181, Dec. 2019).

I have also received final reports from previous Hansjörg Eichler recipients Weixuan Ning, Raaes Khan, and Bohao Dong, as well as drafts of reports from previous Marlies Eichler recipient Trevor Wilson. All four of these reports are now published here in this issue of the *ASBS Newsletter*! I continue to update the spreadsheet started by Dan Murphy when he was Vice-President, which follows reporting of grant winners for both Eichler funding schemes. I am happy to report that ASBS is now up to date with having received reports for previous winners of both schemes, and getting them published in the newsletter!

These reports are extremely important to the Society and our efforts to continue supporting quality research with positive outcomes. The Hansjörg Eichler and Marlies Eichler reports are actually read by a broad membership base and help publicise early career researcher profiles in published form. The Society views these as 'grant reports with a difference', and it is a timely reminder to all Eichler recipients that completing the report at the end of the grant (Hansjörg Eichler) or at the end of each year of the grant (Marlies Eichler) benefits both the recipient as well as the Society. In 2021 I plan to put together a short list of tips for preparing Eicher reports that will go on the website to help support students in this process.

ASBS Research Committee

In 2020, we said thank you and goodbye to David Glenny, Manaaki Whenua – Landcare Research, who stepped down from the committee in late 2019. The 2020 ASBS Research Committee was otherwise very similar to the previous two years, comprising:

- Heidi Meudt (Chair, *ex officio* as VP ASBS), Museum of New Zealand Te Papa Tongarewa
- Joanne Birch, The University of Melbourne, Australia
- Murray Henwood, The University of Sydney, Australia
- Sarah Mathews, Centre for Australian National Biodiversity Research, Canberra, Australia
- Katharina Nargar, Australian Tropical Herbarium, Cairns

I would like to extend a huge thank you to the members of the Research Committee, who generously and consistently provide thor-

ough, thoughtful and constructive reviews for each and every applicant. This year they were called upon for three grant rounds which involved a grand total of 13 applicants!

Hansjörg Eichler Research Fund grants

This year we had two rounds of the Hansjörg Eichler Research Fund, which is targeted primarily at students and non-salaried researchers, but of course any ASBS members are welcome to apply. The March round this year garnered four total applications, two of which were funded at $5000 AUD each:

Aiden Webb, MSc student, The University of Melbourne. Project: 'Phylogenetic inference of *Caesia* and *Corynotheca* (Asphodelaceae) and taxonomic clarification of an Australian species complex, *Caesia parviflora*'. Supervisors: Dr Joanne Birch (The University of Melbourne), and Dr Russell Barrett (National Herbarium of New South Wales). Total amount awarded: $5,000 AUD.

Luis Williamson, PhD student, The University of Adelaide. Project: 'Evolution of Australian sundews–the genus *Drosera*'. Supervisors: Prof Michelle Waycott and Dr John Conran (The University of Adelaide). Total amount awarded: $4,970 AUD.

The September round this year garnered six total applications, two of which were funded at $5000 AUD each:

Sophie Newmarch, MSc student, Massey University. Project: 'Origin and diversification of *Libertia* (Iridaceae)'. Supervisors: Assoc. Prof. Jennifer Tate, Dr Richard Winkworth (Massey University), Dr Joanne Birch (The University of Melbourne), Dr Bee Gunn (Royal Botanical Gardens Victoria), Dr Dan Blanchon (Unitec). Total amount awarded: $5,000 AUD.

Duncan Nicol, PhD student, The University of Otago: 'The evolution and biogeography of the subtribe *Celmisiinae* and the *Celmisia* subgenus *Lignosae*'. Supervisors: Dr Janice Lord, Dr Tina Summerfield, Dr Ralf Ohlemuller, Patricio Saldavia (The University of Otago). Total amount awarded: $5,000 AUD.

Marlies Eichler Postdoctoral Fellowship

This year we had three excellent applicants for the single yearly round of the Marlies Eichler Postdoctoral Fellowship. The Committee funded one of these applicants for $10,000 ASD per year for two years:

Dr Rachael Fowler, Postdoctoral Research Fellow, The University of Melbourne. Project: 'Exploration of the *Eremophila glabra* complex'. Total amount awarded: $20,000 AUD.

The number of applicants for both the Hansjörg Eichler and Marlies Eicher grant schemes this year was high, with multiple applications of very high quality, and the competition was fierce! This seems to buck the trends of consistently low applications and a slight downward tendency that we were seeing in the last few years.

Congratulations to the successful applicants in all of these grant rounds. We look forward to receiving their reports in due course to find out how these funds have supported them to progress their research projects. For those whose applications were unsuccessful, I hope they will take on board the constructive criticism from the ASBS Research Committee and apply next year with revised applications. In 2021 I plan to put together a checklist for preparing Eicher applications that will go on the website to help support students in this process.

ABRS student travel grants

In June 2020, the ASBS signed an agreement with the Commonwealth, represented by Department of Agriculture, Water and the Environment in Australia, to administer a total of $16,500 of funds for ARBS Student Travel Grants in 2019-2020 and 2020-2021 (half in each financial year). Due to COVID-19 travel restrictions, we have not yet implemented this scheme. The next steps are to set up the guidelines, application pathway and timeline to award these funds.

Systematics of endemic New Zealand *Pittosporum* (Pittosporaceae)

Bohao Dong University of Waikato

The genus *Pittosporum* is the largest and most diverse member of the Australian-centred family Pittosporaceae, which comprises 9 genera and more than 200 species (Chandler et al., 2007). Species of *Pittosporum* are widely distributed in Australia, New Zealand, Oceania and the paleotropics, but they are not present in the Americas or Europe (Cooper, 1956; Allan, 1961; Haas, 1977). The majority of *Pittosporum* species are endemic with restricted distributions (Gemmill et al., 2002), including all 25 recognised New Zealand species (Schönberger *et al.*, 2019).

New Zealand *Pittosporum* are usually small evergreen trees or shrubs with verticillate branches (Cooper, 1956). The New Zealand plants have simple, alternate or pseudo-whorled leaves with entire or lobed margins (Figure 1), although *P. dallii* has unusual toothed margins. The leaf shapes are diverse, ranging from linear and linear-oblanceolate to linear-oblong and narrow-lanceolate to obovate or ovate (Figure 1). The solitary or fascicled flowers are pedicellate or sessile and can be terminal or axillary. Approximately 60% of New Zealand species have white flowers (Godley, 1979); however, in general, New Zealand *Pittosporum* flowers present a rich variety of colours, including white, cream, yellow, pink, red, dark red, pale purple, purple and black (Figure 2; Allan, 1961; Cheeseman, 1925; Cooper, 1956; Eagle, 2006; Wilson, 1993). Although the flowers appear perfect, many New Zealand species are functionally unisexual (Godley, 1979). The woody capsules of New Zealand species have 2–4 valves with either black or red seeds. The seeds are usually immersed in a viscid and fragrant oily resin. The leaves, petals, sepals, pedicels, ovaries and capsules are usually tomentose when young (Allan, 1961). A distinctive feature of seven small-leaved New Zealand *Pittosporum* species is their divaricating habit, in which the shrubs have fine stems and the branches are spread apart at wide angles. In addition, nine species of New Zealand *Pittosporum* have heteroblastic development.

Although the *Checklist of New Zealand Flora* (Schönberger et al., 2019) recognises 25

Figure 1 Leaves of New Zealand *Pittosporum*. **A.** Juvenile leaves of P. *anomalum*. **B.** Pseudo-whorled leaves of *P. cornifolium*. **C.** Unusual toothed margins of *P. dallii*. **D.** The abaxial leaf surface of *P. crassifolium* showing the white tomentum. **E.** The undulate margins of *P. eugenioides*. **F.** The small cordate leaves of *P. obcordatum*. **G.** Juvenile leaves of *P. patulum*. Photos by NZ Plants, University of Auckland (A), Bendle (C and D), all others by Heenan (B, E, F).

Figure 2 The variety colours of New Zealand *Pittosporum*. **A.** P. *umbellatum*. **B.** *P. cornifolium*. **C.** *P. kirkii*. **D.** *P. colensoi*. **E.** *P. pimeleoides* subsp. *pimeleoides*. **F.** *P. obcordatum*. Photos by the Huatoki Native Plant Nursery.

species of *Pittosporum*, the delimitations of some of the species that are characterised by small leaves are problematic. A series of phylogenetic studies (Chandler et al., 2007; Hathaway, 2001; Gemmill et al., 2002; Gemmill et al., unpubl. data) on New Zealand and Pacific *Pittosporum* indicated that the New Zealand species may have resulted from two colonisation events, one each from Australia and New Caledonia, with the subsequent formation of two lineages. However, Hathaway's study (2001) had only one sample of each New Zealand species and did not include new species, such as *P. roimata*, while other studies focused on Australian as well as Pacific species. Therefore, morphological analyses and comprehensive phylogenetic studies are needed to systematically review New Zealand *Pittosporum*, which have not been revised since the last treatment was published by Allan (1961).

Given the above, my PhD project is using a multi-pronged approach to comprehensively review New Zealand *Pittosporum* while focusing on the following questions:

1) What are the evolutionary relationships among the New Zealand taxa?

2) Is the current classification of recognised species congruent with phylogenetic analyses?

3) Is the current classification supported by analyses of morphological character state variations?

4) How have important characteristics, such as heteroblasty, heterophylly, the divaricate habit and flower gender, evolved?

With the support of the Hansjörg Eichler Scientific Research Fund, I have made progress on the first of these aims, which I will report on here. To date, I have analysed 91 sequences from a total of 60 *Pittosporum* individuals. Of these, 55 samples and 65 DNA sequences (*ITS* and *psbA-trnH*) were obtained from the previous research performed by my main supervisor Dr Chrissen Gemmill of the Pacific Biosystematics Research Laboratory at the University of Waikato, Hamilton, New Zealand. To date, I have sequenced an additional 17 samples for *psbA-trnH* and five for *trnL-trnF* from dried leaf material in silica gel. One DNA sequence of *Pittosporum kirkii* was obtained from the herbarium sheet at herbarium AK, and four DNA sequences were obtained from GenBank. All newly generated sequences were funded solely by the Eichler grant.

We concatenated the *ITS* and *psbA-trnH* sequences and performed preliminary analyses using Bayesian inference (BI; Figure 3). Although ITS and trnL-trnF were combined

in a previous study of *Pittosporum* from Australia and New Zealand (Chandler et al. 2007), *trnL–trnF* was not used here because the sequences were invariant among New Zealand species. The *psbA–trnH* region was chosen to help clarify the relationships and boundaries between species in the problematic New Zealand clades (i.e. the species with small leaves). Nevertheless, the individual *ITS* and *psbA–trnH* BI phylogenetic trees were markedly different, and concatenating them neither significantly improved the resolution nor provided significant Bayesian posterior probabilities for the clades. However, because of the limited sample size, comprehensive phylogenetic analyses of a larger sample of New Zealand *Pittosporum* might yield different results. Notably, the genetic transmission of cpDNA markers is asymmetric (Clegg et al., 1993); thus, *psbA-trnH* exhibits likely maternal relationships in New Zealand *Pittosporum*. To better understand their evolutionary history, *ITS* and *psbA-trnH* need to be analysed and compared separately.

New Zealand *Pittosporum* were resolved into a moderately supported clade (posterior probability, pp = 0.83; two Australian species were used as outgroups) with two sub-clades (Figure 3). The New Caledonian species and New Zealand *P. pimeleoides* formed a non-supported clade (Clade A, pp < 0.6), and the other *Pittosporum* species were resolved into a weakly supported clade (Clade B, pp = 0.62). Within Clade B, there are two sub-clades: Clade C, which consisted of *P. eugenioides* and *P. umbellatum*, was strongly supported (pp = 0.99), but the remainder of the New Zealand *Pittosporum* were resolved

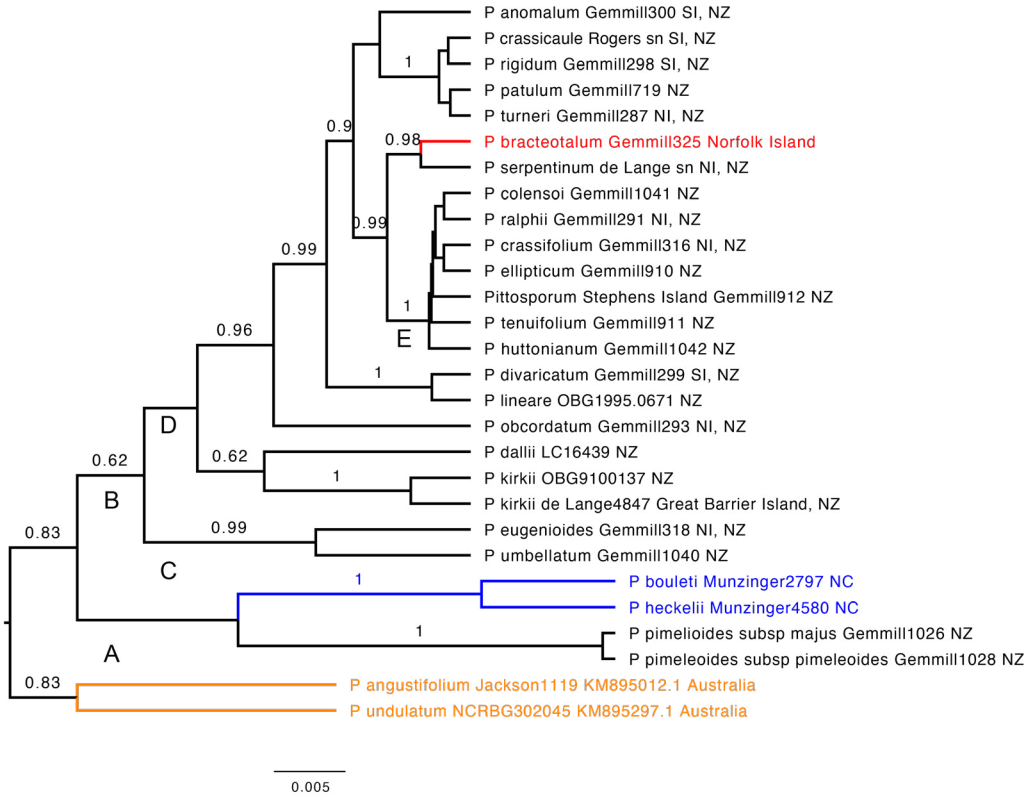

Figure 2 The Bayesian inference phylogenetic tree of New Zealand *Pittosporum* samples based on the nuclear ribosomal internal transcribed spacers (*ITS*) and the chloroplast *psbA–trnH* intergenic region. NZ: New Zealand; NI: North Island; SI: South Island; NC: New Caledonia. New Zealand species are represented with black, Pacific species represented in with red, New Caledonian species represented with blue and Australian species represented with orange. The numbers above the branches are posterior probability values. The letters under the branches are represent different clades.

into the non-supported Clade D (pp < 0.6). The primary, secondary and tertiary subclades of Clade D were strongly supported (pp > 0.9).

In the phylogenetic tree (Figure 3), Clade A comprises New Zealand *P. pimeleoides* and the two sampled New Caledonian species, *P. bouletii* and *P. heckelii*, suggesting that they have a common ancestor. Within Clade B, the Norfolk Island species *P. bracteolatum* is nested within a strongly supported subclade of New Zealand species and is a sister to *P. serpentinum* from the North Cape of New Zealand, which suggests a long-distance dispersal from New Zealand to Norfolk Island. The results suggest that these two species have the same ancestor. *Pittosporum eugenioides* and *P. umbellatum* have a number of similar morphological characteristics, such as larger leaves, umbel flowers, and double-valved capsules. *Pittosporum rigidum* and *P. crassicaule* as well as *P. divaricatum* and *P. lineare* are highly supported as sister species. This result was expected because the species in each of these two pairs are morphologically similar to one another. However, since the *ITS* and *psbA-trnH* sequences of *P. rigidum* and *P. crassicaule* are identical, and Laing and Gourlay (1935) also pointed out these two species only have marked differences in seedling, juvenile, and shade forms, but the mature forms are similar, *P. rigidum* and *P. crassicaule* are most likely the same species. *Pittosporum divaricatum* and *P. lineare* have the same issue. Therefore, molecular phylogenetic analyses alone cannot determine species boundaries in these cases. In addition, while Clade E was resolved into a strongly supported clade, its subclades were not well resolved. Thus, to address these issues, analyses of inter-simple sequence repeat (ISSR) markers will be used. ISSR was chosen as an additional marker system because it can be used to explore species' boundaries when molecular phylogenetics does not provide adequate resolution (Kumar et al., 2016), and it has previously been used successfully in New Zealand Pittosporum (Carrodus, 2009; Clarkson, 2011; Clarkson et al., 2012; Wright et al., 2017).

During the remainder of my PhD studies, I will sample additional species for the molecular phylogenetic analyses and comprehensively examine the evolutionary relationships of New Zealand Pittosporum. In addition, I will observe, measure and analyse the morphological features of numerous species, especially those in problematic groups. To date, multivariate statistical and morphological character analyses have been completed for some of the problematic groups, such as *P. kirkii* from mainland New Zealand and Great Barrier Island, *P. rigidum* from the Tararua Range (southern North Island) and other areas, and small-leaved species, including *P. crassicaule, P. divaricatum* and *P. rigidum*. The morphological characteristics of other species, such as *P. divaricatum* from Tongariro National Park (central North Island) and *P. divaricatum* from other areas, are different. *Pittosporum divaricatum* from Tongariro National Park have narrower leaves that are similar to those of *P. lineare*, an observation which requires additional research. The morphological characteristics from leaves, capsule and flowers will also be observed and recorded and compared to the phylogenetic trees and ISSR data to clarify the evolutionary relationships and provide fundamental data for a future comprehensive revision of New Zealand *Pittosporum*.

Acknowledgments

I would like to express my deepest appreciation to the Australasian Systematic Botany Society for supporting this work through the Hansjörg Eichler Scientific Research Fund, which made the DNA sequencing possible. I would also like to extend my deepest gratitude to my supervisor Dr Chrissen Gemmill. In addition, I would like to extend my sincere thanks to University of Waikato technicians Stacey Meyer and Toni Cornes. This report would not have been possible without the support of Andrea Haines, Jianbang Liu and Xi Wang, who critically read it and gave me constrictive comments to improve my writing skills. A very special thanks to Dr

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Genetic diversity and structure of *Podocarpus lawrencei* and closely-related *Podocarpus* species

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Podocarpus lawrencei Hook.f. (mountain plum pine), is a small shrub that occurs in the alpine regions (Figure 1) of Australia (Australian Capital Territory, New South Wales, Tasmania and Victoria). At one location (Goonmirk Rocks, Victoria), *P. lawrencei* grows up to 13 m tall and is associated with rainforest (Barker 1991). *Podocarpus lawrencei* is morphologically and ecologically close to *P. gnidioides* (New Caledonia), *P. nivalis*, *P. totara*, *P. acutifolius* and *P. laetus* (all from New Zealand), which comprise a well-supported clade in molecular phylogenies (Australis clade) and have been treated as a natural group in taxonomic treatments of *Podocarpus* (e.g. Gray 1956; Knopf *et al.* 2011). This study was designed to develop and analyse novel next-generation sequencing data to investigate questions about *Podocarpus lawrencei* at two levels. First, we aim to elucidate the evolutionary relationships of Australian *P. lawrencei* to the New Zealand and New Caledonia members of the 'Australis clade'. In particular, we aim to address whether the strong similarities between *P. lawrencei* and the extra-Australian species reflect long-distance dispersal, as has been suggested many lineages in the New Zealand flora (Barker 1991; Biffin *et al.* 2010; Knopf *et al.* 2011). Second, we aim to determine the genetic diversity and structure among *Podocarpus lawrencei* populations.

For both aims, we sampled individuals from twelve populations of *Podocarpus lawrencei* in the field, including six populations on the Australian mainland (Victoria and New South Wales) and six from Tasmania. In addition, twelve individuals of *P. nivalis*, eight of *P. totara* (sampled from herbarium specimens)

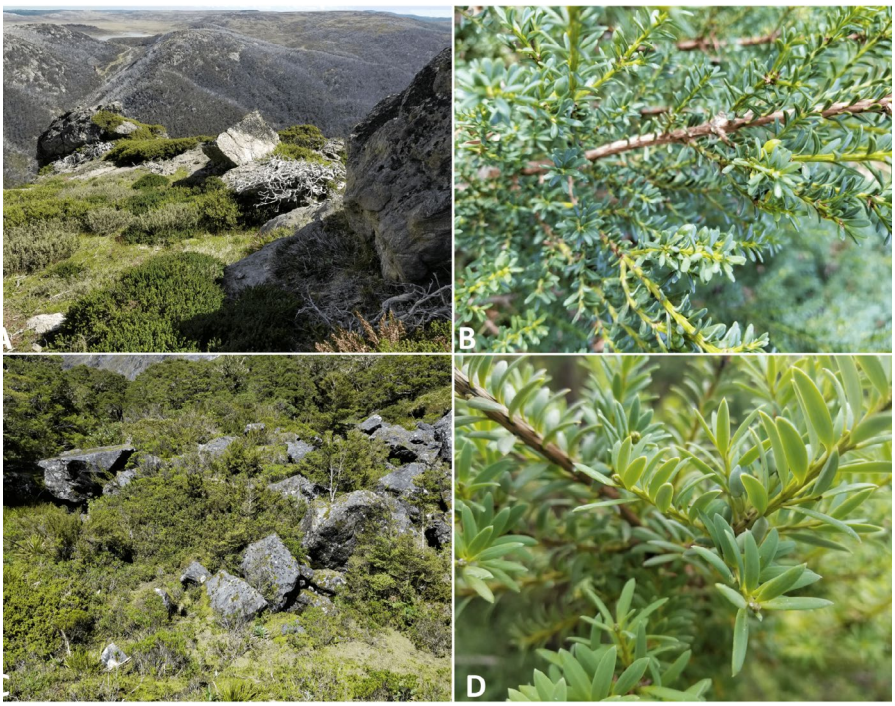

Figure 1 *Podocarpus lawrencei* **(A & B)** at Mount McKay, Victoria (Australia); *P. nivalis* **(C)** and *P. totara* **(D)** at Gertrude Saddle, Fiordland National Park (New Zealand)-Photos by Raees Khan).

Figure 2 The preliminary analysis of the chloroplast data indicate that the Tasmanian population of *P. lawrencei* is the sister taxon of *P. nivalis* (New Zealand).

and six individuals each of *P. gnidioides*, *P. acutifolius* and *P. laetus* were also included.

For the phylogenetic study, hybrid capture and high-throughput sequencing (Hyb-seq; Weitemier *et al.* 2014) methods were used to generate chloroplast and nuclear DNA sequence data sets. Specifically, we developed a 'universal' probe set for conifers, targeting c. 100 nuclear gene regions, using reference sequences from the spruce genome (*Picea abies*: Pinaceae; http://congenie.org/) along with representative conifer transcript sequences from the 1000 Plants Project (1KP; https://sites.google.com/a/ualberta.ca/onekp/) to design the probes. In addition, we utilised a bait set previously developed by the Waycott group (Michelle Waycott *et al.*, The University of Adelaide, unpublished data) that targets c. 50 coding regions of the chloroplast genome across angiosperms, but has been found to recover most of these genes from conifers also (this study). For each sample, DNA sequencing libraries were prepared in the Waycott lab following standard protocols (e.g. Weitemier *et al.* 2014). Following high-throughput sequencing, we used a combination of *de-novo* assembly, Blast search and reference mapping to recover the targeted regions from our samples. Preliminary data analyses were conducted using maximum likelihood phylogenetic analyses on concatenated data sets with 200 bootstrap replicates. While our results are preliminary (c.

50 specimens included), they so far suggest that New Zealand *P. nivalis* is nested within *P. lawrencei*, and is resolved either with Tasmanian (chloroplast data; Figure 2) or mainland Australian representatives of the latter. There is a deep divergence between populations of *P. lawrencei* on the Australian mainland versus Tasmania based upon both the chloroplast and nuclear data sets. Interestingly, the tree form of *P. lawrencei* (Goonmirk Rocks, East Gippsland, Victoria), which has been suggested to be a distinct taxon, was found to be placed within the Australian mainland clade. More detailed phylogenetic analyses (for example, using coalescent models to assess for incomplete lineage sorting) will be required to resolve incongruence between data sets. In addition, ongoing research will focus on increased taxon sampling to assess the relationships of New Caledonian *P. gnidioides* and the other New Zealand species along with molecular dating analyses to inform biogeographic analyses of the group (i.e. estimating the age of disjunctions between landmasses). Sequencing library preparation has been completed for the remaining samples and these have been sent for DNA sequencing.

To address the second aim of investigating the genetic diversity and structure of *Podocarpus lawrencei* and other closely-related *Podocarpus* species (*P. nivalis*, *P. gnidioides*, *P. totara*, *P. acutifolius* and *P. laetus*), I received funding from the Australasian Systematic Botany Society through the Hansjörg Eichler Scientific Research Fund. To obtain the required specimens for this part of the study, I applied for several collection permits for National Parks and different herbaria. Getting a loan of herbarium specimens especially from New Caledonia was challenging, but I was ultimately successful. Other specimens were collected through fieldwork from different populations of *Podocarpus lawrencei*. The funds provided by ASBS were specifically used to cover the sequencing costs of the genetic diversity study of *P. lawrencei*. We again used Hybrid capture and high-throughput sequencing, but this time with a newly designed conifer bait set and another preliminary bait set both developed in the Waycott lab. The preliminary bioinformatics show this method was successful in that we recovered up to 130 nuclear and chloroplast genes for each specimen sequenced. I am hopeful to receive the remaining data by The end of November 2020. We will analyse, write up and submit the manuscript by April 2021.

Acknowledgements

I would like to thank ASBS for the support and funds given through the Hansjörg Eichler Scientific Research Fund that enabled us to complete the sequencing for the population genetic study of *P. lawrencei* and other closely-related species. We also acknowledge the support of Dame Ella Campbell Herbarium-Massey University (MPN), Victorian National Parks, Brisbane Herbarium (BRI), and Adelaide Botanic Gardens (Adelaide and Mount Lofty).

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Phylogenomic analysis of New Zealand polyploid *Azorella* (Apiaceae)

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Many New Zealand genera have a complex evolutionary history involving polyploidy [e.g., (Murray *et al.*, 2011)]. Recent phylogenetic studies of the genus *Azorella* (Apiaceae) throughout its entire range in the southern hemisphere led to the reclassification of six genera (including *Schizeilema* and *Stilbocarpa*) into one, and the genus now contains more than 60 southern hemisphere species (Plunkett & Nicolas, 2017). The current *Azorella* sections *Schizeilema* and *Stilbocarpa* comprise a subalpine lineage of 17 species in New Zealand (16 species) and Australia (1 species) whose ploidal levels may

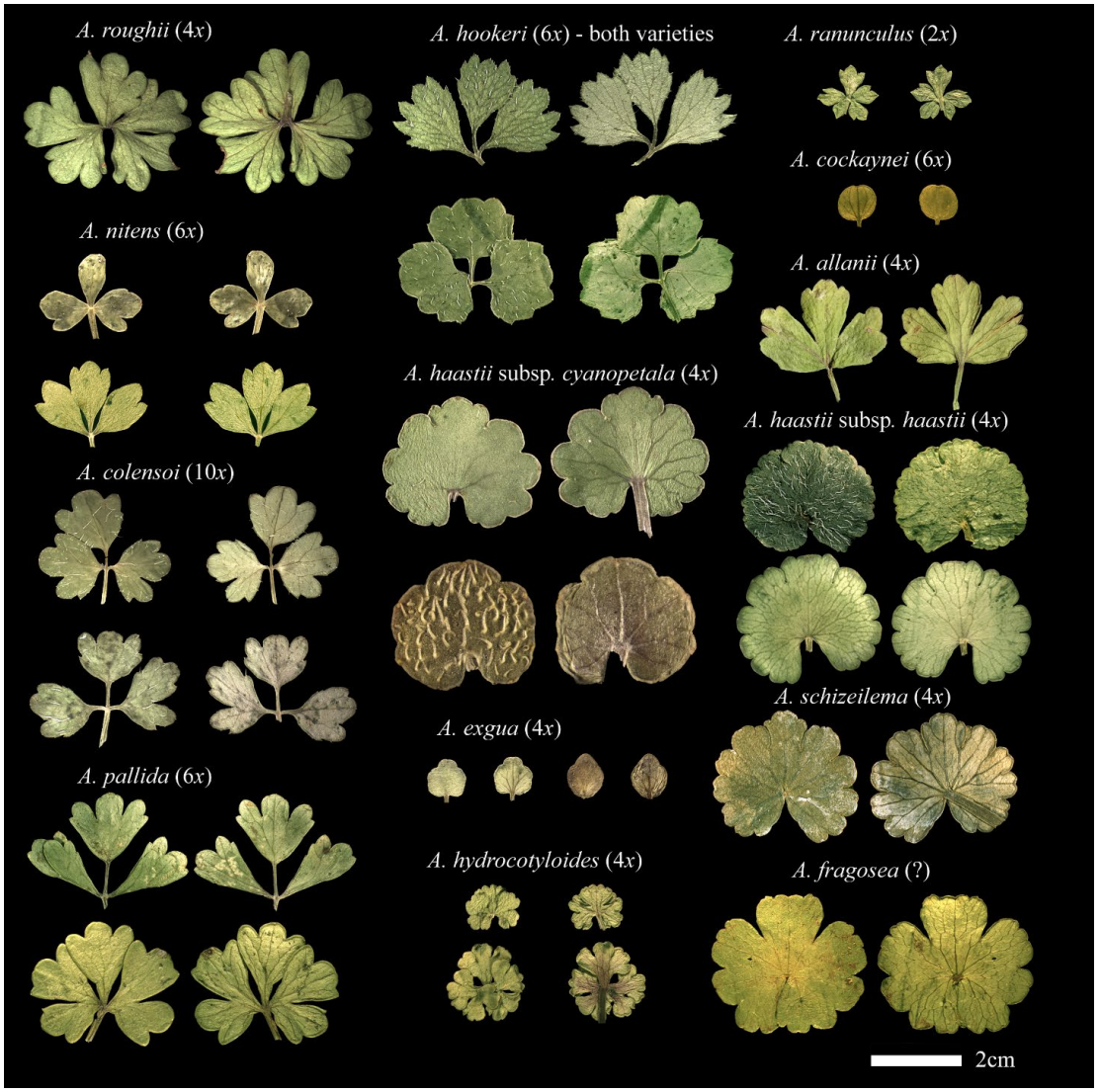

Figure 1 Leaf morphologies and ploidal level (http://www.tropicos.org/project/ipcn) comparison of 14 species of *Azorella* section *Schizeilema* in New Zealand and the sole Australian species, *A. fragosea*. The Chilean diploid species *A. ranunculus* of section *Ranunculus* is also shown for comparison.

Figure 2 Top: Field collection of *Azorella roughii* by Philip Garnock-Jones, Sam Rowland and Weixuan Ning (from left to right) at Mt. Starveall, Western Nelson, South Island, New Zealand, Dec. 2018. **Bottom**: *Azorella roughii.* Photos by Heidi Meudt (top) and by Weixuan Ning (bottom).

be 4*x*, 6*x* or 10*x* (Allan, 1961; Beuzenberg & Hair, 1983; Hair, 1980; Plunkett & Nicolas, 2017). Specifically, *Azorella* sect. *Stilbocarpa* has three species—*A. polaris* (6*x*), *A. robusta* and *A. lyallii*—that are subantarctic island megaherbs (Beuzenberg & Hair, 1983). By contrast, the 14 species in *Azorella* sect. *Schizeilema* are smaller rhizomatous rosetted herbs and all are endemic in New Zealand, except *A. fragosea* which is endemic in Australia (Figure 1).

Previously unpublished phylogenetic trees derived from ITS (internal transcribed spacer) and plastid DNA suggest that New Zealand and Australian *Azorella* originated from diploid *Azorella* ancestors in Chile and Argentina (Nicolas and Plunkett, pers. comm.). A close diploid relative appears to be *A. ranunculus* in *Azorella* sect. *Ranunculus*, previously *Schizeilema ranunculus* (Nicolas & Plunkett, 2012; Plunkett & Nicolas, 2017). However, these high copy number DNA regions (ITS and cpDNA) could not resolve successfully the species relationships among the higher polyploids or predict the most recent common ancestor for the New Zealand and Australian lineage. Thus, in order to understand the diversification of polyploidy in *Azorella* in New Zealand, a better-resolved phylogenetic tree using more informative markers is needed.

With support from the Hansjörg Eichler Scientific Research Fund, I participated in my first botanical field trip. With my co-supervisor Heidi Meudt and my other trip mates Justin Liu (an undergraduate student from Victoria University doing a summer research project) and Sam Rowland (New Zealand Department of Conservation) I learned how to plan and organise a field trip, prepare the necessary gear, identify the plants, and process and press the specimens. At Mt Starveall, I made my first plant collection, *Azorella roughii* (Figure 2). Later, I planned and carried out two additional field trips to collect the leaf tissues of *A. allanii* and *A. nitens* on the North Island (Figure 3). In addition, I spent some time at the Allan Herbarium (CHR) in Lincoln, where I worked with Peter Heenan (Manaaki Whenua - Landcare Research), confirmed the identification of all *Azorella* specimens there, and sampled leaf material from 76 specimens. I also requested leaf samples from three other herbaria (AK, MPN and CANB) to complete the majority of the specimen leaf sampling required for my study (Figure 1).

Even more importantly, the funds I received from the Eichler grant allowed me to purchase the kit to undertake the target enrichment sequencing protocol using the Angiosperm353 single/low copy nuclear gene (LCNG) bait set (Johnson *et al.*, 2018). This approach offers an opportunity to analyze multiple homologous sequences of orthologous genes for any non-model angiosperm species, and it is expected that these markers will be more informative than high copy nuclear genes, i.e. ITS region (Sang, 2002). By analyzing data from the Angiosperm353 markers, we aim to: 1) interpret the origins of the polyploid species in a phylogenetic context; and 2) understand the biogeographic history of *Azorella* sections *Schizeilema* and *Stilbocar-*

Figure 3 **Top:** Field collection of *Azorella allanii* at Mt Maharahara, Ruahine Mountains, southern North Island, New Zealand, March 2019, and **Bottom**: *A. nitens* at Waiohine Campsite, Tararua Mountains, southern North Island, New Zealand, Dec. 2019. Photos by Weixuan Ning.

pa.

To date, we have successfully generated and analyzed LCNG data using the Angiosperm353 bait set for 28 *Azorella* samples and one individual of *Hydrocotyle* (outgroup). These samples comprised 12 fresh field-collected samples and 16 herbarium collections dating back to 1974. These 28 *Azorella* individuals represent 12 species including one individual of the South American lineage, *A. ranunculus*, one individual of *A. fragosea*, and 10 New Zealand *Azorella* species. Among the 10 New Zealand *Azorella* species, there are six species for which multiple individuals have been sampled so far (three *A. colensoi*, three *A. allanii*, three *A. roughii*, five *A. hookeri*, two *A. haastii* and four *A. polaris*).

After trimming the data and extracting the low copy nuclear gene sequences, I realised that the current bioinformatics pipeline does not allow the ambiguous sites to be extracted (Johnson *et al.*, 2016), which can be a problem for polyploid species. The challenge has been discussed by a number of presenters at two recent conferences that I have attended, i.e. the 2019 ASBS-NZPCN joint conference in Wellington, New Zealand and the 2020 Botany conference, which was a virtual meeting in July. For my preliminary analyses, I filtered out the genes that may contain paralogs with Hybpiper (paralog_investigator.py) (Johnson *et al.*, 2016) and used an alignment based only on the ortholog sequences to investigate phylogenetic relationships among the 28 individuals sampled so far.

The resulting phylogenetic tree suggests that New Zealand mainland and Australian *Azorella* species (sect. *Schizeilema*) are more closely related to the Chilean *A. ranunculus* (sect. *Ranunculus*) than they are to the subantarctic species (sect. *Stilbocarpa*) (Ning *et al.*, unpubl. data). The tree also shows that most of the species are monophyletic, except *A. hookeri* which is paraphyletic with *A. colensoi* and *A. nitens* nested within it. More excitingly, there is also variation within populations for species where multiple individuals were included. Thus, the Angiosperm353 trial was successful, and the next steps will be to add more species and populations to this preliminary dataset to reconstruct more fully the relationships and interpret the origins of New Zealand *Azorella* species.

Moving forward, I will also investigate post-polyploidisation diversification traits for New Zealand *Azorella* and test whether they are correlated with ploidy level variation. Specifically, the phylogenetic data will be analysed along with divergent traits that are potentially associated with genome duplication; for example, leaf morphology, genome size estimates (from flow cytometry), and stomata size (measured using scanning electron microscopy, SEM). Publicly available environmental database layers on soil, climate, elevation, etc. will also be analysed in conjunction with the phylogenomic data to reveal the post-polyploidisation diversification in ecological niche space.

Acknowledgements

I would like to thank to the funding supported by the Hansjörg Eichler Scientific Research Fund to help me get this project started. Many thanks to the following herbaria for their assistance in organising specimens and for allowing me to sample leaves from some of their specimens: Auckland Museum (AK), Te Papa (WELT), Manaaki Whenua - Landcare Research Allan Herbarium (CHR), Massey University Dame Ella Campbell (MPN), University of Otago (OTA) and Canberra (CANB, Australian National Herbarium). I wish to thank to my supervisors Jennifer Tate, Heidi Meudt, and my collaborators Antoine Nicolas and Peter Heenan for their excellent guidance and support. Finally, thanks to all those who have helped me with field collections and wet lab preparations.

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Is *Ajuga australis* R.Br. more than one species? Answering a difficult question during difficult times

Trevor Wilson
ABRS Fellow, Australian Institute of Botanical Science, Royal Botanic Gardens and Domain Trust, Sydney

I am currently leading an international team studying the systematics of the Ajugoideae (Lamiaceae), funded by a three-year Australian Biological Resources Study (ABRS) grant. *Ajuga* (Lamiaceae), the key focus of this project, spans from Australia to Africa (1 sp. Australian;~50 spp. total) and, like other members of its family, it contains many horticulturally and phytochemically valuable species (Bouderbala *et al.* 2010; Fekete *et al.* 2004; Harley *et al.* 2004). Surprisingly, apart from a high-level phylogenetic study of the Lamiaceae that included four extra-Australian species (Zhao *et al.* in press), nothing is known about the infrageneric relationships of *Ajuga*, and a global taxonomic study has not been completed. Our aim is to assess the genetic diversity at the population level across the morphological and geographic diversity of *A. australis* R.Br. *sens. lat.* and, by including extra-Australian species in our study, to build the first phylogeny for the genus as well as determine the taxonomic composition of *A. australis sens. lat.* Sampling across the range of this species in Eastern Australia is a large task, and the Marlies Eichler Postdoctoral Fellowship has provided funding that has increased the time available to coordinate and execute the gathering of samples.

Figure 1 *Ajuga australis*, Pilliga Nature Reserve, New South Wales, Australia. Photo: T.C. Wilson.

The interest for reversing large-scale destruction of the environment is gaining traction now that climate change is recognised as a major threat. At their current capacity, restoration and revegetation activities are estimated at around $US 3 trillion per annum globally (Prober *et al.* 2015). Based on this large investment, it is critical that the goals of restoration, such as the re-establishment of self-sustaining populations and the improvement of degraded ecosystems, are achievable. However, without an informed taxonomic understanding of the species that comprise these systems/communities, efforts in restoration are essentially blind to what they must achieve.

Species-complexes present a significant hurdle to achieving a stable taxonomy due to taxonomic boundaries that are difficult to delineate. One such example is *A. australis sens. lat.*, a perennial forb usually restricted

Figure 2 *Ajuga australis*, Capertree National Park, New South Wales, Australia. Photo: T.C. Wilson.

to riparian areas and drainages from northern Queensland to the southern coastline of Tasmania. These areas are found within such diverse habitats as woodland of the Australian Alps and exposed dunes of semi-arid Australia (Harley 2004). Given the breadth of morphological diversity, it is not surprising that Robert Brown described two species in the Sydney region, *A. australis* and *A. sinuata* (Figures 1–3). But, despite the description of these, and later *A. grandiflora* Stapf (Figure 4; Bentham 1834, 1870; Stapf 1933), there was hesitation to recognise more than a single species until a full revision was completed (Eichler 1965; Conn 1999). Unpublished results that analysed morphological data for populations across New South Wales later identified six groups within the taxon (Clarke 2010). However, a complementary analysis of genetic diversity using the ITS and rbcL DNA sequence markers detected no variation, and hence the study concluded that these groups should be considered as subspecies until an intensive population-scale analysis was completed.

To detect variation at a population scale requires a cost-effective technique that can recover high quantity and informative loci across a genome to identify subtleties in admixture and recombination between lineages at the population scale. Diversity arrays technology sequencing (DArTseq) is one such technique gaining popularity for taxonomic and population studies (Rossetto *et al.* 2018) because it is capable of recovering a dataset of thousands of informative loci. Using this technique as a data source for population-genetic and phylogenetic analyses, we aim to achieve a global understanding of the evolutionary history for *Ajuga* and then produce an informed revision of the genus. The ability of technologies such as DArTseq to quantify relationships at multiple taxonomic hierarchies also better informs us of the processes of speciation (Georges *et al.* 2018; Hundsdoerfer *et al.* 2019) and, by complementing this with an examination of morphological diversity and karyotype, we plan to investigate mechanisms underpinning habitat shifts and diversification throughout Australia. Although this project prioritises systematics and taxonomy-based outcomes, a downstream benefit is that the data we produce will be delivered to the framework of the Restore & Renew conservation strategy (Royal Botanic Gardens Sydney), a tool designed to inform conservation practitioners on how to assess if populations are genetically diverse and resilient (Rossetto *et al.* 2018).

The devastating Australian bushfires over 2019 and 2020 represent an outstanding demonstration of the need for species resilience. Together with the continuing global pandemic, the fires have furthermore been without doubt a massive disruption to research in biology, including the first year of the Ajugoideae ABRS project. Even where habitats were not entirely razed, compromised infrastructure has necessitated the closure of parks, and thus prevented the collection of samples at several of our target sites in northern New South Wales (e.g. Wollombombi falls). The additional layer of a

Figure 3 *Ajuga australis*, Coolah, New South Wales, Australia. Photo: T.C. Wilson.

pandemic has caused State border closures (e.g. Queensland), preventing field trips to other Australian States and Territories, and imposing logistical challenges (e.g. limited exposure to the public) for field trips within N.S.W.

Despite the challenges of 2020, most of the sampling for *Ajuga australis sens. lat.* could be completed. The primary goal—an assessment of genetic diversity across the breadth of morphological and geographic diversity for this taxon—can now be carried out by sequencing the existing sample set of over 40 populations (>240 accessions). This sample set was obtained in-part by three collection trips (Tasmania, northern N.S.W., and western N.S.W.). However, a large number of samples was also provided by numerous volunteers from other States who collected and sent us samples. This outpouring of assistance across Australia has buffered many of the negative effects of 2020 on the *Ajuga* project, and it underscores the great value of a collaborative botanical community. The biggest triumph of this project so far may have been the community participation, although the timing of the Tasmanian trip in late February 2020 was also a boon, since the trip was made only weeks before Australian travel bans were imposed.

Based on anecdotal observations in the field and an examination of specimens over the last year, there appears to be some support for the morphotypes proposed by Clarke (2010); mainly, we have found different morphotypes growing near one another. The only form, however, found occupying semi-arid areas is *A. australis* subsp. *grandiflora sensu* Clarke (2010), and its sampling is now complete (= 8 populations). Although the breadth of morphological and geographic diversity is now sampled for *Ajuga* across south-eastern Australia, next year will be used to source another ~30 *Ajuga* species. Furthermore, a field trip to Queensland is necessary to not only sample *Ajuga* intensively, but also sample numerous species in the Ajugoideae for other projects, including *Teucrium* and *Clerodendrum*.

The Ajugoideae team is exceptionally thankful for the support from the Marlies Eichler Postdoctoral grant as it has so far provided invaluable time to the principal investiga-

Figure 4 *Ajuga australis*, Kalyarr National Park, New South Wales, Australia. Photo: T.C. Wilson.

tor (myself, T.C. Wilson) with organising and completing field trips as well as organising material from other institutions and collaborators.

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A golden year for *Nuytsia*

Juliet Wege Western Australian Herbarium

Above The golden anniversary front cover of the Western Australian Herbarium's taxonomic journal *Nuytsia*

In December 1970, the Soviet spacecraft Venera 7 became the first to soft land on another planet (Venus) and to transmit data back to Earth, Elvis Presley was welcomed to the White House by President Nixon, Kelly Shepherd was born, and the Western Australian Herbarium founded its flagship taxonomic journal *Nuytsia*. To celebrate the golden anniversary of at least one of these events, a plan was concocted to publish 50 new Western Australian species from 50 genera on separate days of the year and to communicate some of the science behind each discovery through social media. Thanks to a long lead-in time and a great deal of good fortune we have been able to complete the project (*Nuytsia* Volume 31) in the shadow of a global pandemic—we have published one or more species every week since late January in a year-long botanical birthday bash that has left me with an enduring hangover.

The idea behind the anniversary edition was simple but somewhat ambitious and took several years of planning and research to achieve. We had two main objectives: firstly, to promote the science of taxonomy, herbarium collections and our extraordinary flora; and secondly to maximise conservation outcomes by publishing threatened, rare or poorly known species. We started with a rapid assessment of Western Australia's 'known unknowns', the list of more than 1150 putative new species recognised on *FloraBase* under informal phrase names. We short-listed those that were available for study by Herbarium staff and could be progressed to publication within a short time frame, with limited budget and in parallel with other research commitments. We then prioritised conservation-significant species, drawing on in-house taxonomic expertise and forming local, national and international collaborations where appropriate. We also considered species with noteworthy stories of discovery as part of our broader science communication strategy.

A major challenge was a lack of high-quality herbarium material for many of our short-listed species to inform taxonomic decision-making, enable an adequate species description to be prepared or to serve as type material. We obtained collections and data for many species by coordinating a series of field expeditions, one of which led to the rediscovery and description of *Pimelea cruciata* Rye & Wege, a species last collected more than 30 years ago and currently known from just eight plants. But we failed to relocate some of our targets and in some instances had to cancel planned field work due to poor seasonal conditions. Despite these setbacks, we managed to assemble a diverse mix of novel species that enabled us to craft an assortment of taxonomic tales.

A broad audience heard about the scientific treasures held in our collections and the painstaking work of individual researchers, the collaborative nature of taxonomic research, and the efforts of local botanists, botanical consultants and community members in helping us to advance our botanical knowledge. We featured discoveries made by citizen scientists (e.g. *Goodenia quartzitica* K.A.Sheph., *Gompholobium glabristylum* C.F.Wilkins & Sandiford), horticulturally significant finds (e.g. *Geleznowia amabilis* K.A.Sheph. & A.D.Crawford, *Lechenaultia orchestris* K.A.Sheph. & Hislop and *Thomasia julietiae* K.A.Sheph. & C.F.Wilkins) and a potentially extinct grass that is known only from material collected in 1877 by Ferdinand von Mueller (*Deyeuxia abscondita* T.Macfarlane).

While beautifully photographed gems such as *Wurmbea flavanthera* T.Macfarlane, A.P.Br. & C.J.French and *Kunzea dracopetrensis* R.Butcher caught the appreciative eye of many, an anecdote about Andrea's Wedding Bush (*Ricinocarpos digynus* Hislop & Wege), a plain-featured species with tiny flowers that lack petals, was surprisingly widely celebrated, proving that a terrific tale can be told for any discovery (and that everyone loves a good wedding!). Also well-received was a murder mystery that led to the conviction and description of *Isotropis iophyta* Wege & R.W.Davis, a toxic plant known to cause kidney failure in sheep and cattle.

The volume contains a series of delightful dedications, among them *Philotheca richardsoniana* Wege & Hislop, named for our *FloraBase* fulcrum Ben Richardson, and *Arthropodium vanleeuwenii* S.J.Dillon, named for Pilbara botanical survey specialist Stephen van Leeuwen, who this year took up a position at Curtin University as Australia's first Indigenous Chair for Biodiversity and Environmental Science. The indefatigable Barbara Rye, having described hundreds of new species, finally chose to name one for her husband on Valentine's Day (*Babingtonia peteriana* Rye), albeit a species with warty stems. This story was accompanied by a photograph of Barbara and Peter in full flight during one of their gold medal roller-skating performances, which captured the hearts of many.

It is difficult to gauge the impact of our social media efforts and whether any lasting benefit was achieved for the considerable effort that was involved; however, it has been gratifying to see the online engagement and to receive

Above A selection of conservation-listed species published in the golden anniversary of *Nuytsia*. Top, L to R: *Philotheca richardsonia*[1]; *Lechenaultia orchestris*[2]; *Pimelea cruciata*[3]; *Microcorys elatoides*[1]; *Babingtonia peteriana*[1]. Bottom, L to R: *Kunzea dracopetrensis*[1]; *Calytrix insperata*[4]; *Darwinia sphaerica*[1]; *Styphelia capillaris*[5]; *Arthropodium vanleeuwenii*[6]. Photos by [1] R. Davis, [2]K. Shepherd, [3]J. Wege, [4] K. Thiele, [5]F. & J. Hort and [6]S. Dillon.

Above Top, L to R: Ryonen Butcher collects *Tephrosia* in the Kimberley[1]; Rob Davis photographs *Verticordia elizabethiae*[2]; Barbara Rye with *Babingtonia peteriana*[2], a species named for her husband and roller-skating partner (R). Bottom, L to R: Juliet Wege examines *Stylidium shepherdianum*[3]; Carol Wilkins clutches the type of *Gompholobium glabristylum*[3]; Kelly Shepherd wraps cuttings of *Lechenaultia orchestris* in damp toilet paper for subsequent propagation at Kings Park & Botanic Garden[2]. Photos by [1]Lizzy Joyce, [2]Juliet Wege, [3]Kelly Shepherd.

positive feedback during conversations or via email. I'm hopeful that some of our stories and messages—particularly those centred around the importance of taxonomy and herbarium collections in underpinning conservation—have filtered through despite the challenges of 2020. Indeed, the most satisfying aspect of this project was seeing 42 conservation-listed species named and described, among them four threatened species (*Bossiaea reptans* T.Macfarlane & J.H.Ross, *Quoya zonalis* K.A.Sheph. & Hislop, *Stenanthera localis* Hislop and *Styphelia capillaris* Hislop) and four rarities published under grants awarded by the Australian Biological Resources Study (*Hibiscus chrysinocolla* McLay & S.J.Dillon, *Microcorys elatoides* T.C.Wilson & Hislop, *Stylidium shepherdianum* Wege and *Tephrosia cardiophylla* R.Butcher).

Many of the conservation-listed species published this year were discovered in the past 25 years through surveys of mining tenements by industry consultants (e.g. *Acacia lachnocarpa* R.W.Davis & Hislop, *Dampiera prasiolitica* Hislop & K.A.Sheph., *Schoenus coultasii* Hislop), regional government surveys (*Darwinia sphaerica* R.W.Davis & Rye, *Hemigenia diadela* G.R.Guerin & Wege, *Tecticornia enodis* K.A.Sheph.) or opportunistic collections by keen-eyed botanists (*Calytrix insperata* Rye, *Olearia adpressa* Hislop, *Teucrium diabolicum* R.W.Davis & Wege). Several are known only from a single collection or population and most require further survey to better understand their distribution and conservation status, a task made easier by the descriptions and information published through this initiative.

While most of the species in this year's anniversary edition are vascular plants, two attractive red algal species (*Champia patula* Huisman & G.W.Saunders and *Leptofauchea lucida* Huisman & G.W.Saunders) and a slime mould (*Clastoderma confusum* K.J.Knight & Lado) were included to highlight ongoing international collaborations on these groups. The slime mould proved hugely popular on social media and was unexpectedly highlighted in the May issue of *BBC Wildlife Magazine*. The anniversary edition was further publicised through series of popular articles, radio interviews and a stellar TV debut by Kelly Shepherd who talked about species discovery on *Gardening Australia*.

The golden anniversary of *Nuytsia* has been

a protracted affair that has involved a significant number of people. I thank everyone for their support of this hare-brained initiative, especially the botanists and curatorial staff at the Western Australian Herbarium and additional contributing authors. I also acknowledge those who reviewed manuscripts, provided specimen loans and images or otherwise engaged with the project through social media, as well as other journal editors who have dealt with papers on the Western Australian flora that may otherwise have come to *Nuytsia* this year.

Over the five decades since *Nuytsia* was founded we have made significant progress in documenting Western Australia's exceptional botanical diversity and continue to name and describe new species at a globally significant rate. But with more than 1,100 putative new plant species currently known in Western Australia, our stories of discovery will continue well beyond this golden anniversary. I encourage you all to get writing!

Next year's volume of *Nuytsia* will be managed by Kelly Shepherd and will open to new submissions from 17 January 2021.

Managing taxa and their names – a synthesis of recent articles

Kevin Thiele Taxonomy Australia

In the *ASBS Newsletter* 183, Thiele (2020a) explained why problems arise when digital biodiversity information (which is now a significant and growing proportion of all recorded biodiversity information) is organised and indexed using the names of taxa rather than taxa themselves. Briefly, taxon names are not good surrogates for taxa in computer systems, because a taxon name may change while the taxon circumscription does not, and a taxon circumscription may change while its name does not. These behaviours of taxon names did not cause serious issues while biodiversity information was managed and organised mostly in people's minds, but they cause real and present problems now that much biodiversity information is managed by computers. In computer terms, a taxon name is a very poor record key in a database.

Thiele (2020a; modified and improved in Thiele 2020b) proposed that three changes are needed in our current systems and practices for managing taxa and their names and the biodiversity information associated with them. These are: (1) ensure that taxonomic papers explicitly (rather than implicitly) record changes in taxon circumscriptions; (2) build taxon identifiers (as well as taxon name identifiers) and a mechanism for recording the relationships between taxon concepts into the National Species Lists; and (3) reference published taxon circumscriptions rather than solely taxon names when connecting a biodiversity object (such as a specimen, image, DNA sequence etc.) to a taxon.

These articles were, as hoped, the beginning of a welcome conversation about this important issue. In the last *Newsletter*, Barker et al (2020) provided a critique of the first part of Thiele's scheme and recommended an alternative method for recording changes in circumscription in taxonomic papers.

This article seeks to clarify the differences between the Thiele (2020a,b) and Barker *et al.* 2020) schemes for explicitly recording changes in taxon circumscriptions in taxonomic papers, points out that both schemes would be an improvement on current practice, and recommends that authors of taxonomic papers should be free to choose either, but should employ at least one of these methods.

The problem, restated

Both Thiele (2020a, b) and Barker *et al.* (2020) agree that serious inadequacies in current practice are causing real and present problems in the way we as a community manage biodiversity information in our computer systems. The problems are best explained diagrammatically.

Firstly, at the core of all taxonomy and of our management of biodiversity information is our agreed taxonomic classification. This is conveniently represented as a tree of taxa. As well as arranging taxa, taxonomies such as these are often the basis for organising and indexing other objects and information, such as specimens, images, descriptions, DNA sequences etc. (Figure 1).

However, taxonomies change as our knowledge grows. These changes sometimes involve changes in the circumscriptions and/or names of taxa. For example, Thiele (2019) split *Hibbertia spicata* F.Muell. into six species. One of these, for nomenclatural reasons, retains the name *H. spicata* F.Muell., but has a much narrower circumscription. We thus now have two different taxa (in the sense of two different taxon circumscriptions) that bear the same name (Figure 2), a pre-2019, broadly circumscribed species (sometimes designated *H. spicata sens. lat.*) and a post-2019, narrowly circumscribed species *(H. spicata sens. str.*).

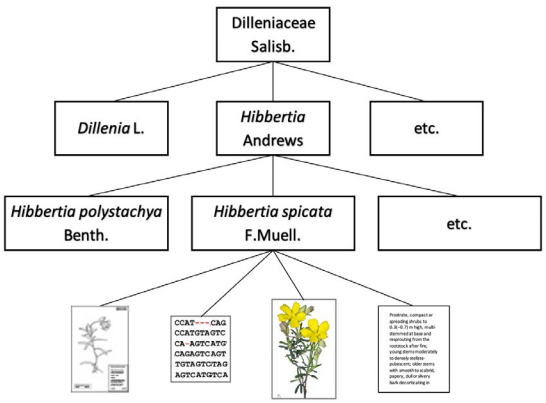

Figure 1 A typical taxonomy with a number of physical and digital objects indexed to *Hibbertia spicata*

The problem with indexing biodiversity data using names alone (such as '*Hibbertia spicata* F.Muell.') immediately becomes apparent – if a name is all that is used, then it becomes impossible to tell whether objects and information indexed as '*Hibbertia spicata*' belong to *H. spicata sens. lat.* or *H. spicata sens. str.* Over time, objects may be reindexed from *H. spicata* to one of the newly named taxa. Once this is complete, all remaining objects still indexed to *H. spicata* should belong to *H. spicata sens. str.*, but until that time the indexing will be ambiguous.

This problem has real-world consequences. For example, until all specimens in all herbaria in Australia are curated to the new taxonomy (if accepted), the map of *Hibbertia spicata* in the Australasian Virtual Herbarium is *neither* a map of *H. spicata sens. str. nor* a map of *H. spicata sens. lat.*, but is an ambiguous mix of the two.

This is the more serious of two problems that bedevil our biodiversity information systems. The second is the contrasting case where a taxon remains the same but its name changes (through the discovery and adoption of a prior name, or transfer of the taxon from one genus to another). In these cases, the links to objects and other information break, and need to be manually fixed.

The solution to these problems lies in finding a convenient way to link objects to a *taxon circumscription* (sometimes called a taxon concept) rather than a taxon name. If that can be done, then objects indexed under *Hibbertia spicata sens. lat.* remain indexed there, correctly, until some are reindexed to *H. spicata sens. str.* or its segregates. The question is how best to index by taxon circumscriptions.

Names, taxa, circumscriptions and name instances

The key to a solution is to understand that each species in the Figure 2 is a cluster of published taxon circumscriptions. In the National Species Lists (which includes the Australian Plant Name Index and Australian

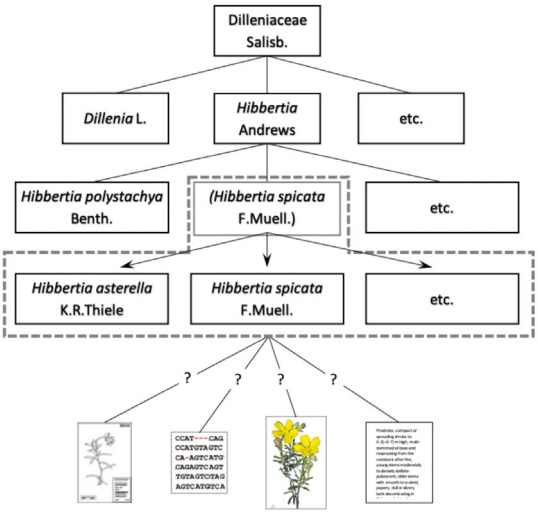

Figure 2 A new, revised taxonomy. *Hibbertia spicata* has been split into several species, one of which retains the name. There are now, thus, two different circumscriptions for *H. spicata*, a broader one (dotted line) and a narrower one (shaded). By default, all objects previously indexed against *H. spicata* follow the name; many of these will now be incorrectly indexed, as they will in fact belong to one or other of the segregate species.

Plant Census), these are called taxon name instances. Before 2019, there were ten name instances for *Hibbertia spicata* in the NSL (Figure 3). Each instance is a circumscription, and includes synonyms (if any).

We are very fortunate in Australia to have the Australian Plant Census, a consensus mechanism for managing an agreed taxonomy for Australian plants. The APC process has endorsed one of these name instances (in bold in Figure 3) as the normative instance for this taxon (in the NSL, this instance has the 'APC tick'). Because of the central role of the APC in managing plant biodiversity information in Australia, in effect all objects indexed to the name *Hibbertia spicata* are indexed to this taxon name instance (the dotted line in Figure 3).

In 2019, a new name instance was added to *Hibbertia spicata* by Thiele (2019). In this case, *H. spicata* sensu Thiele 2019 is a new circumscription (it is *H. spicata sens. str.*, while the CHAH 2011 instance is *H. spicata sens. lat.*). Now, if the APC accepts this as the new normative instance for *H. spicata*, then it will gain the CHAH endorsement. The problem is that, by default, all objects indexed as '*H. spicata*' will then be treated by our computer systems as belonging to this new circumscription (Figure 4). This will be incorrect, as only some are likely to belong there.

This is the heart of the problem. Fortunately, it can be readily solved if objects are indexed using a *taxon circumscription* rather than a *taxon name alone*. If some objects are indexed using *Hibbertia spicata* F.Muell. *sensu* CHAH 2011, while others are indexed using *Hibbertia spicata* F.Muell. *sensu* Thiele 2019, the ambiguity and errors are resolved.

In practice, this requires only a minor change in taxonomic practice, a change that is one part of the three-part solution proposed by Thiele (2020b). For example, current practice when determining specimens is to write the taxon name alone onto the determinavit slip (e.g. Figure 5, left-hand slip). But the name

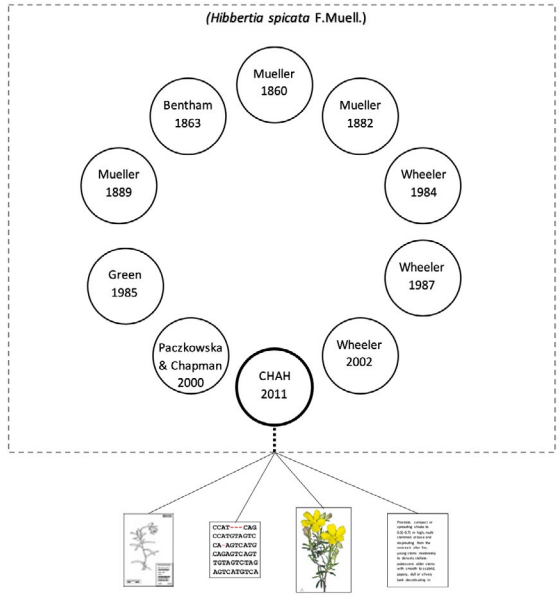

Figure 3 The name instances for *Hibbertia spicata* in the Australian Plant Census. One name instance (in this case CHAH 2011) is endorsed by the Australian Plant Census as the normative name instance for this taxon. Given the central role of the APC in managing plant biodiversity in Australia, in effect all objects indexed to *Hibbertia spicata* are indexed to this instance.

alone cannot discriminate between different circumscriptions, hence specimens so determined are ambiguously indexed. Simply writing a reference to a taxon name instance (by appending a publication reference after the name) can fix this (Figure 5, right-hand slip).

Relationships between name instances

Having a way to assign biodiversity objects and their information to a taxon circumscription rather than just to a taxon name is one part of the solution. Another part is knowing the relationships between the different taxon circumscriptions that share a name.

In Figures 3–5 the taxon circumscriptions (taxon name instances) that share the name *Hibbertia spicata* are all independent, and their relationships to each other are uncertain. Some of them may be the same circumscription, some may be broader or narrower circumscriptions than others. The National Species Lists currently has no

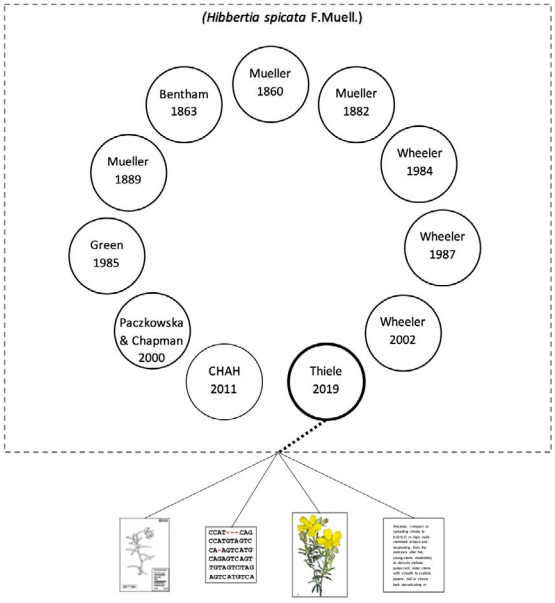

Figure 4 In 2019 a new name instance was added to *Hibbertia spicata* in the Australian Plant Census. If this is endorsed by the Australian Plant Census as the normative name instance for this taxon, then in effect and by default all objects indexed to *Hibbertia spicata* will be indexed to this new instance. Some of these will not in fact belong to that taxon circumscription.

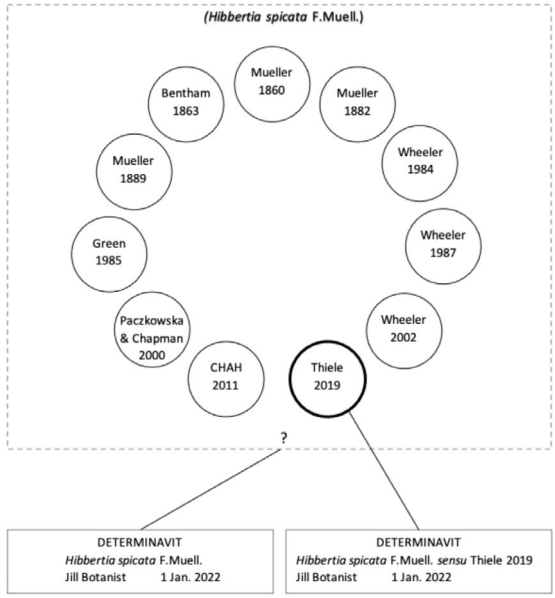

Figure 5 Two determinavit slips. The left-hand slip uses a name alone; the specimen to which it is attached cannot be unambiguously assigned to a taxon circumscription in the Australian Plant Census. The right-hand slip explicitly references a name instance and hence its specimen can be unambiguously assigned.

mechanism for recording and storing these relationships between taxon name instances. Being able to store these relationships is essential if we are to solve the problem.

The need for this can be seen by comparing Figures 3 and 4. Imagine that *H. spicata sensu* Thiele 2019 is identical in circumscription to *H. spicata sensu* CHAH 2011, and the APC tick is moved from CHAH 2011 to Thiele 2019. As identical circumscriptions, there would be no problem with re-indexing to Thiele 2019 all the specimens, images and other objects that were previously indexed to CHAH 2011. However, if *H. spicata* Thiele 2019 has a narrower circumscription than *H. spicata* CHAH 2011, then there may well be a problem if this re-indexing happens. We need to know the relationship between these two circumscriptions to know if there is a problem or not.

Thiele (2020a, b) and Barker *et al.* (2020) both agree that we need to explicitly record these relationships in taxonomic papers, and differ

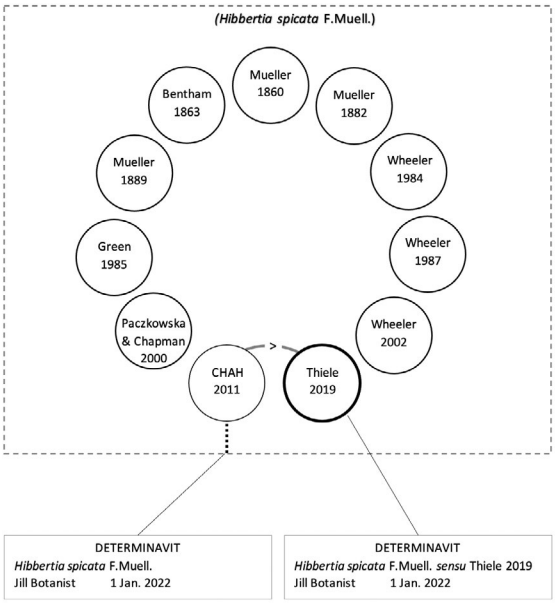

Figure 6 Thiele (2020b) proposed that the relationship between a new taxon circumscription (Thiele 2019) and the previously accepted circumscription (CHAH 2011) should be explicitly recorded in taxonomic papers. Historical determinavit slips that use the name alone are assumed to be assigned to the taxon circumscription that is normative at the time the mechanism is put into effect (in effect, matching current default behaviour). Going forward, new determinavit slips are unambiguously connected with either the previous circumscription or the new one.

mainly in the scope of relationships to be recorded, and the way in which they should be recorded. Thiele (2020b) proposed that taxonomic papers should explicitly record the relationship between a new circumscription and *the normative circumscription* (the one with the APC tick) at the time the paper is published (Figure 6), and that this could be conveniently done in a plain-English summary at the end of each paper.

Barker *et al*. (2020), by contrast, proposed that taxonomic papers should explicitly record the relationships between a new circumscription and *all previous circumscriptions* (Figure 7), and that this should be done in what they term an 'extended synonymy' using the normal conventions for taxonomic synonymies. The Barker *et al*. proposal is thus broader and more inclusive in scope, and draws on historical practice rather than suggesting a new practice. Importantly, both proposals, if adopted, will solve the problems raised in these papers.

Advantages and disadvantages of the two proposals

Given that both proposals solve the problem, how are taxonomists to choose which to use? In many ways this can and should be a personal preference. Some taxonomists regularly use extended synonymies in their current practice while others do not, and some journals mandate or encourage extended synonymies while others do not.

I believe the Thiele (2020b) proposal has three main advantages. Firstly, being a minimal solution, it adds very little work to already time-challenged taxonomists (and database managers). Every taxonomist will be able to straightforwardly record the relationship between a new taxon circumscription and the one accepted by the APC at the time of publication. In some cases, however, it will be more challenging to record relationships with historical circum-

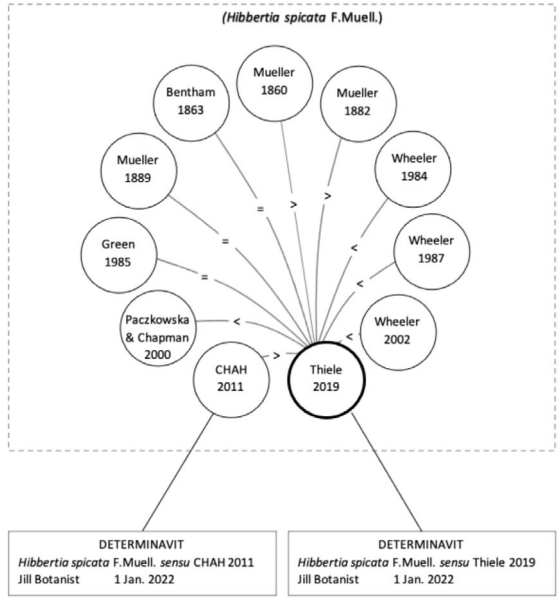

Figure 7 Barker *et al*. (2020) proposed that relationships between a new circumscription and all previous circumscriptions should be recorded in taxonomic papers. Symbols on relationships: = — equals; > — includes; < — is included in.

scriptions. For example, in Figure 7 it would be challenging to determine the relationship between *H. spicata sensu* Thiele 2019 and *H. spicata sensu* Mueller 1860; this cannot be done through literature alone, and would require an understanding of what specimens were available to Mueller in 1860, a potentially time-consuming task.

Secondly, the relationships between circumscriptions are stated in plain English rather than in 'taxonomic English'. If we have an overall goal of making our taxonomies more accessible to the interested public (and I believe we should have such a goal), then this must be an advantage.

Thirdly, and perhaps more subtly, the scheme proposed by Thiele (2020b) separates nomenclature from taxonomy (that is, the management of names from the management of taxon circumscriptions). While such a separation is not strictly necessary, I believe it clarifies this important distinction – nomenclature is all about names and types, but taxonomic circumscriptions are not.

The Barker *et al*. (2020) proposal has two main advantages. Firstly, it draws upon and reprises what some regarded historically as best practice, the view being that current practice in many instances has 'slipped' and lost rigour. Thus, it does not 'reinvent the wheel', as pointed out by Barker *et al*. (2020). Secondly, by recording relationships between more circumscriptions, it provides richer information. At times, these richer relationships will be meaningful. For example, referring to Figure 7, if a description of *H. spicata* from the Wheeler 1984 publication is one of the digital objects being managed, then having an explicit relationship between Wheeler 1984 and Thiele 2019 would be useful. While most digital objects in our universe of biodiversity information are currently indexed by name only, a small number can in principle be tied to specific name instances, and the management of these would be improved by the richer relationships proposed by Barker *et al*. (2020).

Next steps

As Thiele (2020b) explained (and see the introduction to this paper), the problem of ambiguously indexed biodiversity information needs a three-part solution; until all three parts are in place, the problem will not be solved. The three parts are as follows:

1. Taxonomists need to begin explicitly stating in their taxonomic papers the relationships between a new taxon circumscription and previous ones (discussed above).
2. The National Species List needs to build mechanisms for capturing and managing the relationships between circumscriptions (name instances), and for helping taxonomists and other users understand and use these.
3. Taxonomists and others need to begin indexing biodiversity objects and information using circumscriptions (name instances) rather than just names (by, for example, adding a circumscription reference to determinavit slips after the name).

Of these, the first can begin immediately. Taxonomists writing papers should consider choosing either of the two alternative solutions (the extended synonymy of Barker *et al*. 2020, or the circumscription table of Thiele 2020b); given that both will work in this context, this can be a personal choice. It would be most convenient to state which method is being used in the paper's Methods section.

The third can also be commenced, although our information systems are not yet ready to fully capture extra information (references) on e.g. determinavit slips. The full solution can then be enabled when the NSL is able to manage taxon circumscription relationships, and our other information systems (such as the Australasian Virtual Herbarium and Atlas of Living Australia) can handle information indexed by taxon circumscriptions rather than just taxon names.

Why we need to do this now

If we as a taxonomic community do not deal with the issues raised in Thiele (2020a, b) and Barker *et al*. (2020), then the ever-increasing amount of biodiversity information we store,

manage and share using computer systems will continue to be compromised by ambiguity. In the best case we will need to do more work to manage and curate these systems as taxonomies change and knowledge grows; in the worst cases we will continue to provide misleading and at times incorrect information to our users and stakeholders, many of whom do not have the deep knowledge of taxonomy to understand the complexities and subtleties of the situation.

The first thing to do if one finds oneself in a hole is to stop digging. The proposals in Thiele (2020a, b) and Barker *et al.* (2020) aim to achieve exactly that. If we do nothing, the problem will only grow.

Acknowledgements

Thanks to Ben Richardson, Anna Monro and Bill Barker for very useful discussions on this issue and for comments on and improvements to the article.

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Further reading

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Illusive Illyarrie

Greg & Bronwen Keighery

Figure 1 A tree Illyarrie near Cervantes. Photo: B. & G. Keighery

Seeing that the wonderful Illyarrie (*Eucalyptus erythrocorys*) was Eucalypt of the year (*ASBS Newsletter* 182/183, page 35) for 2020, we wish to share some observations about the flowering and fruiting of this Eucalypt in the wild.

Illyarrie was one of the first non-local WA plants that Bronwen was exposed to. A family friend, Frank Phillips, grew WA wildflowers and in the late 1950s gave a young Illyarrie to her father Frank Banyard for their new garden in Floreat Park. Frank Banyard then began propagating his own Illyarrie. Greg Keighery and Bronwen Keighery (née Banyard) still have two Illyarrie 'trees' in their garden from this line. We were curious as to why our garden Illyarries were mallees, not trees as we knew them to be in the Cervantes area at the southern edge of their range (Figure 1). As a consequence our first investigation began in the late 1970s when Greg was at Kings Park and we went on a family jaunt to collect seed capsules from these southern trees. When we got there we could not find any mature fruit. We postulated that the garden introduction was self-fertile and had come from a population at the northern end of the species range where they grew as mallees.

Some three decades later, without children, we began our investigations again. In addition to our earlier observations we had noted that, among the thousands of images of this species and its flowers in publications and on the internet, there were very, very few in the wild. Also, nearly all herbarium material is in fruit, not flowering. No problem, we thought, as the plant is a late summer/autumn flowering Eucalypt of the northern sandplains of Western Australia. March in this region being rather hot (30–45^{0}C), the area is shadeless with many attendant ticks and flies, and few other species are in flower. Any sensible botanist/photographer would be working in a herbarium/lab or air conditioned office.

For the past 5 years we have endeavoured to photograph the glorious mass flowering of the dense populations of this species in the wild, concentrating on the dense stands present on limestone ridges between Jurien Bay and Dongara (Figure 2). To our surprise this has been a dismal failure. Even in wet years when the underlying dense populations of *Acacia spathulifolia* (after fires) turn the area gold in spring, we have never ob-

Figure 2 Limestone ridge population. Photo: B. & G. Keighery

Figure 3 (top) The ground under the trees littered with aborted branchlets with buds.

Figure 4 (bottom) A closer view of the abscission point. Photos: B. & G. Keighery

served a mass flowering or even a reasonable flowering of Illyarrie. The species also does not seem to be affected by past fires. Plants in cultivated rows in the towns in the area and in Perth can be positively dripping with blossom, but only 1–10% of wild trees have a few blossoms present. We have recorded heavy bud formation in several years, only to later record the ground below the trees covered with the branch ends bearing these semi to nearly mature buds (Figure 3). At first we thought that the local cockatoos and/or weevils were pruning the buds, but no, they all had a definite abscission layer (Figure 4) with no evidence of predation. The trees themselves are dropping the buds. Unlike street or garden plants they also don't retain the few large fruits once mature.

Consequently, despite many visits we have never observed a heavy or even a reasonable flowering of this species in the wild. We are becoming very puzzled as to what triggers bud formation and why the buds are deliberately lost. As yet we have not been able to locate any images of mass flowering or met anyone who has observed the mass flowering of this species. Have you?

Addendum

Alex George

On 9 March 1974 I collected Illyarrie in flower east of Green Head (A.S.George 11783, PERTH). Although not as prolific as it often is in cultivation, it was still impressive, especially being towards the end of summer when few species are flowering (though autumn is the peak flowering season for banksias in the South-West). In his *Eucalypts of Western Australia: The South-West Coast and Ranges* (2019) p. 39, Malcolm French has a photo of a flowering tree in the wild, south-east of Dongara.

Figures 5 & 6 Illyarrie on a limestone ridge east of Green Head. Photos: Alex George

UNITEC Herbarium update

Dan Blanchon Unitec Institute of Technology, Curator Unitec Herbarium

The UNITEC Herbarium is a small herbarium of c. 13000 accessioned specimens based at Unitec Institute of Technology in Auckland. The herbarium is associated with a molecular ecology laboratory (part of the Applied Molecular Solutions Research Centre). The focus of the herbarium is on the lichenised mycobiota with about 70% of our collections in this group, but all taxonomic groups are represented and contributed to by students at Unitec. The herbarium has a small research team which includes Dr(s) Dan Blanchon, Peter de Lange and Mark Large and Mr Andrew Marshall. Dan, Andrew and Peter are working on a range of lichen issues, usually in collaboration with lichenologists in Chicago (Dr Thorsten Lumbsch) and Berlin (Dr Robert Lücking) on New Zealand Peltigeraceae subfamily Lobarioideae lichens (especially the *Pseudocyphellaria crocata* complex), and so called 'Graphid' lichens. Considering New Zealand's recent election result the formal description of *Ocellularia jacinda-arderniae* in December 2019 by the UNITEC team and Robert was notable and perhaps prophetic, though New Zealand's Prime Minister also has an endemic beetle, *Mecodema jacinda* and a Saudi Arabian ant, *Cermatogaster jacindae*, named for her. In the interim Mark Large, Dr David Mabberley and Unitec student Elise Wood have also untangled the right name to use for a New Zealand endemic *Coprosma*, known to iwi as kanono, which they show should be called *Coprosma autumnalis*, rather than *C. grandifolia* and *C. australis* which are now placed in the synonymy of *C. lucida*.

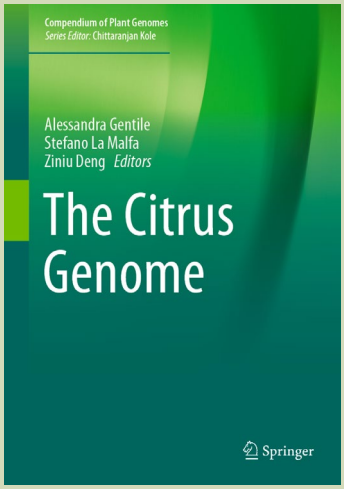
Above Jacinda's barnacle lichen *Ocellularia jacinda-arderniae*, discovered by Dan Blanchon, Peter de Lange, Andrew Marshall and with Peter's son Theo, and described in 2019 in *New Zealand Journal of Botany.* Photo: Unitec blog https://www.unitec.ac.nz/about-us/jacinda-s-lichen-ness.

Erratum

Correction to page 6 of last *ASBS Newsletter* (*ASBS Newsletter* no. 184): Luis Williamson's supervisors are Michelle Waycott and John Conran, not Bob Hill

Sweet... and sour

Book review by David Mabberley



The Citrus Genome

Alessandra Gentile, Stefano La Malfa, Ziniu Deng (eds)

ISBN 978 3 030 10799 4, e-ISBN 978 3 030 15308 3 177 × 254 mm

Springer Nature, Cham, Switzerland, 2020 ['Printed in Australia'] xiv + 294 pp.

$US 249 00 [e-book $US 172 81]

The moving by the Chinese, long ago, of wild *Citrus* species from their original distribution areas into those of other species—with consequent natural hybridization, followed by selection of largely apomictic hybrid lines—is the historical basis for today's mighty citrus industry. By 2016 commercial production exceeded 124 M t worldwide (Australia 0.58 M t), citrus being grown in some 140 countries. Citrus is the most significant warm-temperate fruit-crop.

An up-to-date review of citrus genomics is therefore to be welcomed. By the time this book was assembled, whole-genome sequencing, beginning with *Arabidopsis* (2000) and rice (2002), had been applied to '45 crop plants, eight crop and model plants, eight model plants, 15 crop progenitors and relatives, and three basal plants, the majority in the public domain'—including a sweet orange (*Citrus* × *aurantium* Sweet Orange Group)—in 2013.

The book is one in a continuing series, 'Compendium of Plant Genomes' (edited by Chittaranjan Kole, New Delhi), already including similar reviews on eggplant (*Solanum melongena*), *Allium*, *Capsicum*, *Ocimum*, globe artichoke (*Cynara cardunculus*), neem (*Azadirachta indica*), rubber-tree and radish. The aim of these volumes is reportedly to 'elucidate the background history of the national and international genome initiatives: public and private partners involved; strategies and genomic resources and tools utilized; enumeration on the sequences and their assembly; repetitive sequences; gene annotation and genome duplication. In addition, synteny with other sequences, comparison of gene families and most importantly potential of the genome sequence information for gene pool characterization and genetic improvement of crop plants'.

So, does this review meet this brief for citrus? The book has 16 chapters by a large international cast of authors, covering topics from the history of the crop and conventional breeding including root-stocks, to markers, 'epigenetic modifications', reproductive biology, genomics of ripening, pigments and essential oils, stress-tolerance, and disease-resistance. The breadth of material presented thus goes far beyond the brief and thereby provides a digest of current endeavours across a wide range of citrological research. In this regard it is more akin to books in the CRC series, each volume of which being titled '*The genus XXX*', as in *The Genus Citrus* by Giovanni Dugo and Angelo Di Giacomo (2002).

It is good to see in this new book that the chapter on conventional breeding by Raveh *et al.* has discussion of modern work on peelability in mandarins, the raising of seedless lemons, and the vogue for different peel colour besides the more familiar traits for improved yields and fruit quality. We also learn that until the mid-1800s citrus trees were usually grown as seedlings, grafting becoming much more common only after *Phytophthora* root-rot spread (first recorded in the Azores in 1842 with sour orange being somewhat resistant); that citranges (*Citrus* × *insitorum*) raised in USA in the early C20 were tolerant of tristeza

virus and had some citrus nematode resistance, and that *C. trifoliata* (as widely used today) was the first dwarfing rootstock; more modern approaches using ploidy manipulation have led to triploid seedless cultivars (the Tahiti lime long being favoured for gin-and-tonic), while in China many are now being synthesized from spontaneous tetraploids, and somatic hybridization, notably at the University of Florida (Lake Alfred), has led to tetraploid breeding parents to give seedless triploid mandarins, lemons, limes, pomelos and grapefruit; that huanglongbing (HLB; citrus greening) problems can be countered somewhat by increasing fertilizer levels; and that marker-assisted selection is being used to short-circuit the lengthy juvenile phase to fruiting so inimical to rapid breeding-programs in citrus.

Then, at last, comes the authoritative chapter (8) by Xu and Roose dealing with citrus genomes in the round, from sequence variations to epigenetic modifications, covering methods of genome assembly, linkage mapping, and SNP markers in cultivar identification, besides DNA methylation and consequent effects on flesh versus peel production. The final chapters include sections on the genomics of citrus fruit-ripening; the beneficial health implications of pigments in blood oranges and ruby grapefruit, which have accumulations of lycopene and anthocyanins; and biotechnological approaches to resistance include CRISPR-based genome editing, but it is reported that 'applications remain at the early stage' and that studies of the genetic basis of canker resistance have concluded that 'no resistant genes have been characterized so far'—while there is little discussion of HLB, the world-threatening bacterial disease for the whole citrus industry.

We learn some even more remarkable things. In the chapter on the origin and diffusion of citrus, by Zhong and Nicolosi, we read 'population sizes of the extant wild species, without exception, are too small to do population genetics studies' and, without explanation (p. 7), the seven wild species in Australia (the most *Citrus*-speciose country in the world) 'most probably [comprise] only one or two true species'. Indeed, this chapter disappoints generally in that it is woefully lacking in systematic or nomenclatural insight and in many ways is a backward step from the CRC book.

The chapters have good bibliographies, though (as so often nowadays) largely covering only the latest work, as if little useful was published before this century. On the other hand, the book is remarkable for its unevenness and the enormous amount of repetition, inconsistencies in terminology (e.g. 'varieties'/'cultivars') and citrus nomenclature across the chapters, complete with sloppy writing and poor English in many parts, suggesting that the editing must have been rushed. Particularly unforgiveable in a scientific treatise are extraordinary sentences such as (p. 170), 'To better adapt to the wider range of environmental conditions, many angiosperm [sic], including citrus, adopted the self-incompatibility system to improve their rate of polymorphism'. Surely a reading of Darwin (possibly too 'old'?) is called for?

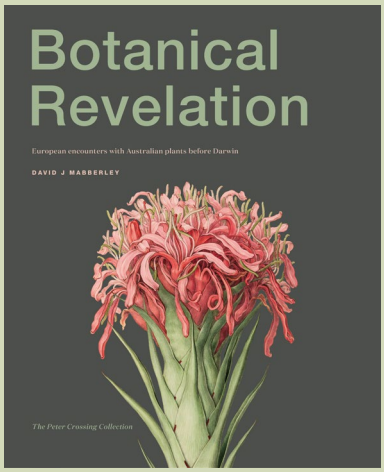
Perhaps unsurprisingly, there is very little discussion of Australian taxa, save reporting the molecular confirmation of the endemic *Eremocitrus* and near-endemic *Microcitrus* being amalgamated with *Citrus* on morphological grounds in the 1990s. Even though the book concentrates on the hybrids that have arisen from Asian species, a modern workable classification with synonymy for those, formulated in Australia almost 25 years ago and adopted in modern floras and data-bases besides the European horticultural trade, seems to have evaded the compilers of this compendium.

To turn to the very beginning of the book, it opens with Eliezer Goldschmidt's wise and sobering Introduction, pointing up the importance, but also the limitations, of genomics in reconstructing the history of the crop ('one of the most, if not the most complicated case'), and admitting that genomics has not led to 'a real breakthrough' in dealing with the currently devastating *huanglongbing* (citrus greening), which has effectively seen off the Florida citrus industry and is always a potential concern for Australia. There is much more to do.

The asking price for this book is, of course, unspeakable.

Wealth, prosperity, and civilization

Book review by John Clarkson



Botanical Revelation: European Encounters with Australian Plants before Darwin

David J Mabberley

ISBN: 9781742236476 (hardback) 300 × 240 mm

NewSouth Publishing, Sydney, 2019, pp. xi, 372.

RRP AUD$89.99, NZ$99.99.

When *Botanical Revelation* arrived from the publishers, I had just finished reading Charles Darwin's account of the *Beagle* voyage (Darwin 1859) so the subtitle, *Encounters with Australian Plants before Darwin*, immediately piqued my interest. In the final chapter, while reflecting on the voyage, Darwin comments on 'the march of progress' in the southern hemisphere, particularly Australia, attributing it to the 'philanthropic spirit of the British nation'. 'To hoist the British flag' he says, 'seems to draw with it as a certain consequence, wealth, prosperity, and civilization'. Would this civilisation and philanthropic spirit shine though in this book?

Botanical Revelation is about the early encounters of Europeans with Australian plants from Willem Janszoon's first sighting of the west coast of Cape York Peninsula in 1606 to Charles Darwin's fleeting visit in 1836. In particular, it chronicles the value of illustration in documenting the diversity of Australia's plants, but it is more than that—way more.

The book is a product of the friendship between the author and Peter Crossing AM, a long-time collector of antiquarian books and paintings, and Peter's late wife, Sally. Work for the current book extended over 4 years and was largely undertaken in Peter's library. This significant collection includes such gems as books from Napoleon Bonaparte's collection from his house at Malmaison, a copy of Ferdinand Bauer's *Illustrationes florae Novae Hollandiae* with an unpublished drawing of a New Zealand conifer, and an original drawing by William Westall. Most of the images in the book are taken from books, manuscripts and original drawings in the Crossing Collection. The work also led to examining little-cited material located in institutions in the United Kingdom, the Netherlands, Austria, Germany, and New York.

The work is impressive at first sight. It measures 300 × 240 mm and at 1.88 kg you immediately get the feeling that you are holding something substantial. The front of the dust jacket features a magnificent, coloured engraving of *Doryanthes excelsa* by Ferdinand Bauer, the back, a previously unpublished watercolour of the same species by highly talented, contemporary Australian artist Susannah Blaxill (Web ref. 1). The plant features again on the frontispiece with a previously unpublished watercolour from the Crossing collection by John William Lewin. The thickness and fold of the dust jacket suggests that something may lie hidden beneath and it does—a map of New South Wales and the rest of Australia by Joseph Cross which appeared in 1826 in James Atkinson's *An account of the state of agriculture & grazing in New South Wales*. This is a novel way of reproducing a map at a scale that would have otherwise been impossible, even in a book of this size.

The text, which is almost exclusively focused

on the books in Peter Crossing's library, is arranged into 7 chapters and includes a foreword by Peter Crossing, a preface by David Mabberley, 7 pages of notes, which readers should not ignore, an extensive bibliography and an excellent index. The chapters are chronologically arranged.

The first (15 pp.) deals with European contact prior to 1770, a legacy which Darwin probably did not have in mind when he spoke of hoisting the British flag. In this chapter the reader is introduced to the first of a dozen or so vignettes that appear throughout the text. Printed in blue ink on a pale blue background, these provide an interesting diversion from the running narrative. The first one features an engraving of *Acacia mangium* produced prior to 1690 by an unknown artist. It is accompanied by notes on the discovery and naming of the plant and its current day importance as a source of pulp and woodchips, and for making furniture, paper and activated charcoal.

The second chapter (53 pp.) deals largely with the actions and influence of Joseph Banks, the dominant figure of the era and perhaps the greatest of the botanical philanthropists. In this chapter the reader finds the first of many reproductions of a frontispiece from a book in the Crossing collection. In this case, a first issue of the 1810 edition of James Lees' *An Introduction to the Science of Botany*. Here the reader learns the pages containing notes by Robert Thornton of Joseph Banks's jilting of Harriet Blosset had been removed from the Crossing copy and new ones pasted in. This practice of including, where known, something of the history of the original owners of the book and their contribution to the narrative continues throughout the text and helps bring the Crossing library to life.

Chapter 3 (65 pp.) sees the arrival of the First Fleet in Port Jackson in 1788 and with it the development of a fascination with growing Australian plants in Europe and even the United States. The spread of seeds and plants through the social networks of nurserymen and private gardeners, which to date has been little documented, is traced. Readers are also introduced to some of the more obscure authors and artists operating in the colony at the time—men like Watkin Tench, a marine captain who produced the first account of the establishment of the colony and the first since Cook to describe the plants of New South Wales; and George Raper, a midshipman from the *Sirius* and John Doody, a convict artist, who produced drawings of landscapes and plants of the new colony.

Contrary to Darwin's view that the 'philanthropic spirit' is a particularly British thing, Chapter 4 (35 pp.) deals with the work from the other side of the English Channel. Even though France was almost constantly engaged in war from1793 to 1814, French botanists, artists and gardeners continued to exchange material with Britain and her colony in Australia. Two men, Labillardière and Pierre-Joseph Redouté, feature prominently. Redouté has been called the greatest botanical illustrator of all time. Amongst several reproductions of works by him is a previously unpublished illustration of *Calomeria amaranthoides*. The work of lesser known people like Auguste Plée, Jean François Turpin, Pierre-Antoine Poiteau and the Italian aristocrat, Alessandro Malaspina, who led a voyage of discovery to the Pacific for Spain, is also discussed. Two full page reproductions of engravings by Plée from Labillardière's *Novae Hollandiae plantarum specimen*, readers learn, were stippled—the first use of this technique in botanical illustration.

In his acknowledgements David states that parts of the text are heavily reliant on his earlier publications and that the book brings together much of his work on Australian plants over the past 40 years. In that time, in addition to the current book, David has authored 4 books on Robert Brown or Ferdinand Bauer (another is currently in press) and had more than a dozen papers published in peer-reviewed journals. Readers might be excused for thinking that there is nothing new to be had in a chapter headed *Brown and Bauer, Australian botany's Gemini* (ch 5, 71 pp.)—but they would be wrong. Bauer's

depiction of *Banksia coccinea* is a good example of this. Readers might think they remember seeing this in *Painting by Numbers* (Mabberley 2017) but that was the finished watercolour. The image in the *Botanical Revelation* is the coloured engraving from Bauer's *Illustrationes florae Novae Hollandiae*. There are other similar examples (e.g. *Brunonia australis*). There are also numerous original works by other lesser known artists of the time such as Henry Cranke Andrews and Andrew Hastings Doyle. Five watercolours by John William Lewin, including a full-page illustration of *Platylobium formosum*, were previously unpublished. I was particularly impressed with two exquisite engravings of seaweeds by William Jackson Hooker, coloured by an unknown artist, that appeared in Dawson Turner's *Fuci*. In the narrative, readers will learn of something of the competition that existed between Brown and men like James Smith and Richard Salisbury and how Banks used his influence with them and others to back away from the publication of material on the plants of New Holland and leave the field to Brown and Bauer.

Running to 75 pages, Chapter 6, *The vogue for Australian plants*, is the longest chapter in the book. It opens with a watercolour and gouache by Joseph Lycett, *North view of Sydney, New South Wales, c 1820*. By this time, the colony had been settled for 32 years. Flinders' *A voyage to Terra Australis* and Robert Brown's *Prodromus* had been published and Darwin's vision of wealth, prosperity, and civilization was being realised. In this chapter we read of the advances in botany and horticulture that were taking place on continental Europe and, with the lifting of the unofficial embargo on the publication of Australian plants now that Brown had published his *Prodromus*, the rise of horticultural magazines and botanical periodicals in England. There is also a lengthy discussion of further revelations being made by collectors like Allan Cunningham. And still previously unpublished works keep coming: Pierre-Joseph Redouté's watercolour on vellum of *Melaleuca citrina* and watercolours of *Capparis mitchellii* and *Santalum murrayanum* by Thomas Livingston Mitchell and *Banksia spinulosa* var *collina* by Edwin Dalton Smith.

When Darwin left King George's Sound in March 1836, encounters with Australian plants were largely Eurocentric and the focus very much on their horticultural potential. The final chapter entitled *The future of botanical revelation* (ch 7, 13 pp.) explores revelations that have been made since and discusses how the focus has shifted to the exploration of internationally traded commodities, many of which had been used traditionally by Aboriginal people, and how the work of Australian-based plant scientists investigating the genetic characteristics of these plants is leading to improved crop yields. The chapter closes with a reminder of the value of illustration in documenting the diversity of Australian's plants and a recognises the international reputations that have been earned by 21st century, Australian-born botanical artists. Many of them have their work included in the Shirley Sherwood Collection, the most important contemporary botanical art collection in the world today.

I would hazard a guess that readers of books would rarely access notes even if they are included as footnotes, but readers should not fall into that habit here. Notes in this book (17 pp.) have been grouped after chapter7 and contain all sorts of interesting snippets. For example: Why did Robert Brown write the name 'Grevillea' on a Dampier wattle? What tree produces bark that when soaked in water and beaten is equal in every aspect to hemp for cordage? and Who was the British earl who married an opera singer at age 81? The book closes with an extensive bibliography (8 pp.), acknowledgements and an excellent index.

I am reluctant to throw brickbats at a book as magnificent as this. Bouquets are the order of the day—armfuls of bouquets. Two minor points which might help in future reprints, of which I am sure there will be many, are issues for the printer. Legends to figures, which really must be read for they are packed full of interesting information, are printed in black with details of the artist and the artwork in

a light shade of grey. This grey text can be difficult to read in anything but the best of light. I found I had to turn on a reading light to make out the details, but then this had the advantage of enhancing my enjoyment of the images. The other comment relates to the reproduction of John Lewin's ghost moths with '*Nicotiana odorata*' on page 203. The image is also reproduced on page vi. The images are reproduced at slightly different scales on different coloured background, but this is not the problem. A lot of the detail on the flowers of the image in the text has been lost, something that I am sure a printer could easily fix.

As Darwin departed King George's Sound he wrote, 'Farewell, Australia! you are a rising child, and doubtless some day will reign a great princess in the South: but you are too great and ambitious for affection, yet not great enough for respect. I leave your shores without sorrow or regret'. Having read *Botanical Revelation*, I would suggest that Australia was already well on its way to earning that respect.

This is not the first time David Mabberley has ventured into this realm and hopefully it will not be his last. Many of David's books in this and other fields have attracted awards for excellence. I would not be surprised if this book adds to his growing tally. Peter Crossing said in his foreword that he was seeking someone who could bring order and context into his collection of books and painting. In David Mabberley he has found a master of the craft.

References

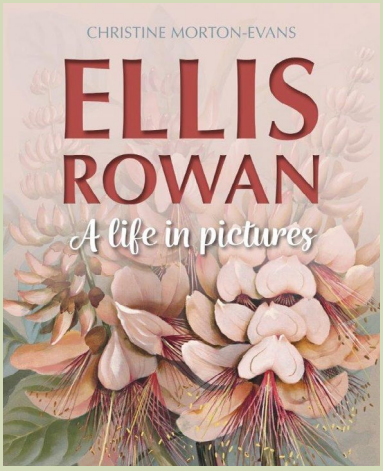
Darwin, C. (1859), *The Voyage of the Beagle* (Reproduced 2009 with introduction by Ruth Patel, Penguin Random House, UK).

Mabberley, D.J. (2017), *Painting by numbers: The life and art of Ferdinand Bauer*, NewSouth Publishing, Sydney.

Web Reference Susan Blaxill https://www.blaxill.com/bio.php

No mere lady flower painter

Book review by Tanya Scharaschkin



Ellis Rowan: A Life in Pictures
Christine Morton-Evans
ISBN 978—642-27957-6 (paperback) 190 × 230 mm
NLA Publishing, Canberra, 2020, pp vi, 192.
RRP $34.99

This is a delightful book about the Australian artist and naturalist Ellis Rowan (1848 - 1922). The book will appeal to botanists and botanical artists alike, as well as anyone interested in the life of an intrepid explorer in days when it was not common for women to be travelling alone. The reader will not be overburdened by minute details as the author has struck a delicate balance between making the book informative and engaging. The book provides a succinct overview of Ellis Rowan's life, ambitions and adventures interlaced with sometimes amusing insights. The book is aesthetically pleasing with numerous images of Ellis Rowan's paintings held at the National Library of Australia interspersed throughout. My curiosity has been sparked and I am keen to find out more about Ellis Rowan and other explorers and artists of her time. Fortunately, a more detailed book *Flower Hunter: The Remarkable Life of Ellis Rowan* has already been written by Christine Morton-Evans and Michael Morton-Evans.

News

Todd McLay

Online and in the media

As good as gold-en wattle

The floral emblem of Australia, *Acacia pycnantha*, will feature on the new Australian $100 note. Phillip Kodela (ABRS) was heavily involved in the design of the note, and ensured that the design used was botanically accurate.

https://www.canberratimes.com.au/story/6990066/enthusiasts-line-up-for-newly-released-100-banknote/?cs=14225

Should we change species names to honour indigenous peoples?

A provoking paper by two Kiwi academics, suggesting that scientific names should reflect indigenous names. Their example of New Zealand kauri *Agathis australis* becoming *Agathis kauri* is feasible, but less clear is the case of Queensland kauri, *Agathis robusta*, which has a distribution encompassing dozens of languages (and two countries).

Link to story: https://www.scientificamerican.com/article/change-species-names-to-honor-indigenous-peoples-not-colonizers-researchers-say/?fbclid=IwAR3qnc0ayxN2xRZHXs-R0Bex6203smiJm_pIhrc8n_WOQHvlFlOm-8MMr-Tus

Link to paper: https://www.nature.com/articles/s42003-020-01344-y

Orchid people

Short interviews with three orchid-experts/obsessives, including Katharina Nargar from the Australian Tropical Herbarium

https://www.abc.net.au/news/2020-10-04/orchids-have-became-a-global-obsession-meet-three-enthusiasts/12729260?fbclid=IwAR22vKYn2ERuE3oivXiWhtREQFII-aTtB03KxYStexNcudKdZH9Q-KWWt0xU

A serendipitous discovery of a new daisy genus

Alexander Schmidt-Lebuhn (CSIRO) tells a story about how a search for the nearest Australian relatives to a weed (cape ivy, *Delairea odorata*) led to the discovery of a new genus of daisies, now called *Scapisenecio*.

https://theconversation.com/we-accidentally-found-a-whole-new-genus-of-australian-daisies-youve-probably-seen-them-on-your-bushwalks-139754?fbclid=IwAR1nuxBgkok3lL3hBzEL_JDPQo-P7n1E-C9QN6PTzVZf4o6fYUTP5WXnru4U

A series of seminars on weed management after bushfires (with a Victorian focus), running weekly from the 25th of November. Topics include prioritisation, collaboration, and identification of weeds. Watchable either as a Teams meeting, or streaming on Youtube (check the website for details).

https://www.swifft.net.au/cb_pages/weed_management_after_fire_-_webinar_series.php?fbclid=IwAR3UhIPbLaQnofXbnIVvm-LUYGth7W5UMo2u8gsGYWK6onZPDjUnX_tShWSc

ABC Gardening stories featuring Australian herbaria

A couple of ABC Gardening stories focusing on the work done in Australian herbaria. Always nice to see friends and colleagues on the telly!

More to discover: Kelly Shepherd (Western Australian Herbarium) talks about naming new species, and how important that is for conservation.
https://www.abc.net.au/gardening/factsheets/more-to-discover/12772136

Plant Hunting: Laura Simmons (Queensland Herbarium) on using herbarium specimens to help plant identification
https://www.abc.net.au/gardening/factsheets/plant-hunting/12880738

Solanaceae seminars

Part of the ever-increasing move to online seminars is this series on Solanceae, encompassing many different disciplines of research on the family. Of particular interest to ASBS readers will be the seminar by Chris Martine and Angela McDonnell on the phylogeny, taxonomy, and breeding systems in Australian Solanum.

https://physaloidseminars.weebly.com/upcoming-seminars.html

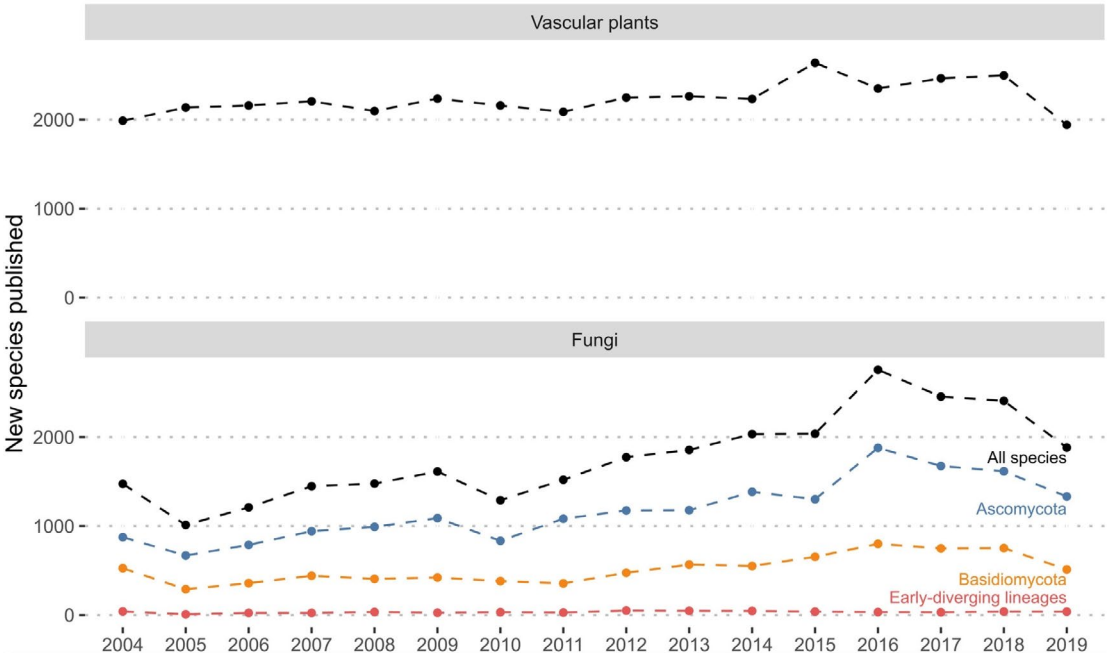
Chris Martine and Angela McDonnell on Australian Solanums: https://www.youtube.com/watch?v=QrJdX59T6Y0&feature=youtu.be

Papers and publications

New species of plant and fungi

A nice and thorough review on the new taxa of plants and fungi described in the last 15 years (2004-2019). Areas covered include the number of new taxa, regions of the worlds those taxa were named, and those that are of commercial, medicinal, or pathogenic potential.

New scientific discoveries: Plants and fungi - Cheek *et al.*, 2020, Plants People Planet https://nph.onlinelibrary.wiley.com/doi/10.1002/ppp3.10148



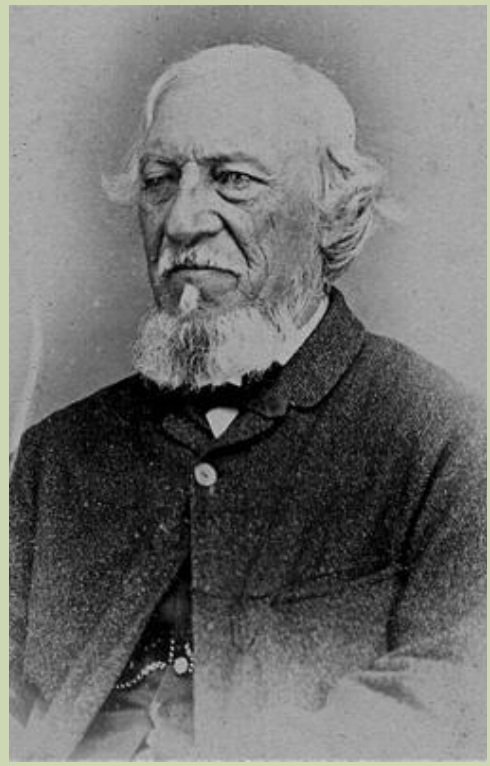
Extracting information from herbarium specimen images

With the ever increasing number of imaged herbarium specimens, the next step will be how those images can be used for feature extraction of morphological data. This paper investigates how these emerging methods could work and where they might fail.

Schrödinger's phenotypes: Herbarium specimens show two-dimensional images are both good and (not so) bad sources of morphological data - Borges *et al.*, 2020, Methods in Ecology and Evolution.

Link to journal page: https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.13450?campaign=woletoc

Link to biorxiv (preprint): https://www.biorxiv.org/content/biorxiv/early/2020/04/01/2020.03.31.018812.full.pdf



The private museum of John Septimus Roe, dispersed in 1842

The paper is based on a collection of 201 letters by Roe to members of his family, written between 1807 and 1829, and acquired by the State Library of New South Wales in 2009. It discusses his interest in collecting specimens (mainly zoological and ethnographic) for a museum at the family home in Newbury, Berkshire. The museum was sold and dispersed in 1842 and its whereabouts are now unknown. In 1829, Roe sailed with the first settlers to the Swan River as Surveyor General of Western Australia.

M.Fishburn, *The private museum of John Septimus Roe, dispersed in 1842*, Archives of Natural History 47: 166–182 (April 2020).

https://www.euppublishing.com/doi/abs/10.3366/anh.2020.0629

Southern beech phylogeography in New Zealand

The five species of native southern beech are major components of forests in New Zealand, except for the so-called "Beech gaps". This paper presents the first molecular phylogeographic analysis in four of these species confirms these gaps as important biogeographic barriers that likely emerged in the Pliocene-Pleistocene.

Plio-Pleistocene environmental changes shape present day phylogeography of New Zealand's southern beeches (Nothofagaceae) - Rawlence *et al.*, 2020, New Zealand Journal of Botany.

https://www.tandfonline.com/eprint/DCXEPIU6XVD96CAY9D3B/full?target=10.1080/0028825X.2020.1791915

The Wehl family and Mueller

Continuing their research into the history of botany in Australia, and especially that of Ferdinand von Mueller, the authors detail the relationship between Mueller and the Wehl family of South Australia and their contributions to botany (which includes significant collections and botanical art).

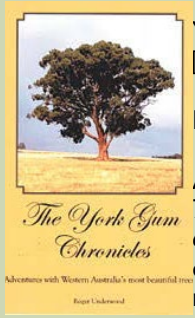
The Wehl family of South Australia and their botanical connections with "Dear Uncle" Baron Ferdinand von Mueller - Dowe *et al.*, 2020, Swainsona.

https://data.environment.sa.gov.au/Content/Publications/JABG34P001_Dowe.pdf

The York Gum Chronicles: Adventures with Western Australia's most beautiful trees.

The latest in a series by retired forester Roger Underwood, derived from a lifetime working with trees, growing and admiring them. It has essays on 34 trees, well illustrated with photographs of trees, wood products and people, many of historical interest. Roger has written ten books including *A Botanical Journey: The story of the Western Australian Herbarium* (2011).

Roger Underwood, *The York Gum Chronicles: Adventures with Western Australia's most beautiful trees*



York Gum Publishing, [Palmyra] (2020).

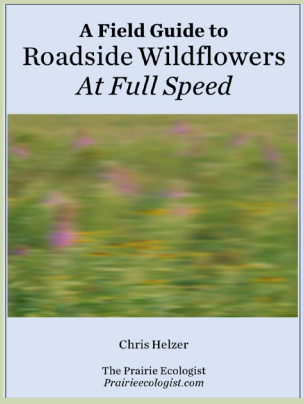
Price $30.00; postage $6.00.

Available from the author, 7 Palin Street, Palmyra WA 6157, yorkgum@westnet.com.au; (08) 9339 4055; mobile 0429 339405.

For a smile

When you are in the United States next: *A Field Guide to Roadside Wildflowers at Full Speed*

https://theprairieecologist.files.wordpress.com/2020/01/a-field-guide-to-roadside-wildflowers-at-full-speed_january2020-1.pdf



The newsletter

The ASBS newsletter keeps members informed of society events and news, and provides a platform for debate and discussion. The newsletter is published quarterly on the ASBS website and in print. Original articles, notes and letters (not exceeding ten published pages in length) are encouraged for submission by ASBS members.

Have an article or an idea for the newsletter?
Send it to Lizzy (Editor):
lizzy.joyce@my.jcu.edu.au,
or Alex (Associate Editor):
a.george@murdoch.edu.au

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Half page: $100
Flyers: $250

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The society

The Australasian Systematic Botany Society is an incorporated association of over 300 people with professional or amateur interest in botany. The aim of the society is to promote the study of plant systematics.

Membership is open to all interested in plant systematics. Members are entitled to attend general and chapter meetings, and to receive the ASBS *Newsletter*. Any person may apply for membership by filling in a membership application form available at http://www.asbs.org.au/asbs/membership.html, and forwarding it to the Treasurer. Subscriptions become due on 1 January each year.

The ASBS annual membership subscription is AUD $45, and a concessional rate of AUD $25 is offered to full-time students, retirees and unemployed people. Payment may be by credit card or by cheque made out to Australasian Systematic Botany Society Inc., and remitted to the Treasurer. All changes of address should be sent directly to the Treasurer as well.

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