Newsletter

Australasian Systematic Botany Society

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Australasian Systematic Botany Society (ASBS)

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In this issue

From the President

Mike Bayly

New President Mike Bayly at Mount Macedon, Victoria, making videos for online teaching. Photo: Alison Kellow.

I am both extremely honoured and a little nervous about taking on the role of ASBS President. The society plays a key role in our taxonomic community and has been a constant part of my botanical life, since attending my first ASBS conference as a PhD student in 1993. The society does a tremendous job of nurturing the careers of developing systematists, advocating for our sector, and building a strong sense of community among a geographically scattered workforce. This has been fostered by a long history (approaching 50 years!) of strong leadership by past councils/presidents, hard-working newsletter editors, and the willingness of members to engage with us. I hope that long-continues and that I can do my bit to keep the wheels moving in the right direction.

A (minor) changing of the ASBS guard

I am pleased to be joining a great Council of colleagues and friends. As announced in the last *Newsletter*, the key council positions of Vice President, Treasurer, Secretary and Councillor remain in the very safe hands of the previous incumbents, Heidi Meudt, John Clarkson, Hervé Sauquet and Katharina Nargar, respectively – who have all, of course, been doing terrific work on our behalf. Apart from me, the other newbie on this Council (although returning to a role she previously held in 2015/2016) is Kelly Shepherd. It is great to be working with such a team and I hope the continuity of positions will allow us to work efficiently and to continue with the initiatives that are already in the wings.

On behalf of the Society, I'd like to thank outgoing President, Dan Murphy, and Councillor, Ryonen Butcher, for their substantial contributions during their time on Council. And, I'm sure I will bug Dan with questions as things progress.

What are we up to?

The new Council took the reins heading into the end-of-year season, but quickly settled down to work. There has been a strong enthusiasm for Council to meet regularly (maybe we've all got used to endless Zoom meetings?), and we have committed to schedule monthly meetings, hoping that will maintain momentum with Council proceedings.

Apart from the regular business of running the society, some key matters on the table at present are the following:

- From discussions at the last AGM, it is clear that some members feel strongly that that the society's funds should be invested in an ethically defensible manner, in particular reducing investment in fossil fuels and other environmentally-damaging extractive industries. For a society concerned with the study of biodiversity, that is a reasonable stance to take. Council will investigate this matter over the coming months and John Clarkson has already been gathering information for us. Of course, we are very mindful of our significant financial assets and their importance to running the Society and meeting our goals in promoting the study of plant systematics. We will be looking to tread the line of maintaining our financial position and income stream, taking an ethical approach to our investments, and

maintaining an investment portfolio that is not overly onerous for the Society (and in particular the Treasurer) to manage.

- We are starting to scope out approaches to updating and enhancing the ASBS website. At some stage soon it will likely need to leave its long-term home on servers in Canberra and that will create a chance to rejuvenate the site and hopefully improve its functionality to aid the running of the Society and promotion of what we do. Kelly Shepherd has been doing the initial work on this, and will continue this in the coming months.

- We are starting to cast an eye to how we might celebrate the 50th anniversary of ASBS (see note later in *Newsletter*).

- John Clarkson has been doing a sterling job of obtaining refunds from the ATO on franking credits for past years, back as far as 2003 so far. This has required delving though old financial records, quizzing past Treasurers for information, and dogged determination in dealing with the ATO. That has resulted, so far, in refunds of $17,676.39 in the last year, which will all help our ability to support plant systematics. I can't imagine any other council member tackling the task with the gusto that John has!

Cover image

We are continuing the tradition of reflecting the research interests of the current President on the cover of the *Newsletter*. I have chosen, with some hesitation, an illustration of *Veronica baylyi* Garn.-Jones by Jodie Verney (née McLay). Although I love the illustration, I am more than a bit uncomfortable about choosing a species named after me [as a nom. nov. for the illegitimate *Veronica carnosula* (Hook. f.) Hook. f.], but have been persuaded to do so despite the awkwardness. The illustration is a link to my long-term mentor, collaborator and friend Phil Garnock-Jones who published the name. It is a link to (former) student, colleague and friend, Todd McLay, who commissioned the illustration, by his sister, as a present on completion of his PhD, based on material cultivated by Phil. It is also a link to a formative and exciting period in my botanical life (1996–2005) spent in New Zealand revising/monographing groups in the *Veronica* complex – probably the most substantial piece of work I'll ever do! And, as I feel that NZ is my second home, and being a strong supporter of the Australasian scope of our society, I thought it would be great to have a New Zealand endemic plant on the cover for the first time.

The year ahead: 'see' you in Cairns

It is hard to know how the COVID situation will play out for the next year. I'm sure it has had different impacts on all of us. I have been to the office for only one day since March 2020, and I'm writing this in a week where I'm in the bizarre situation of trying to teach what is usually a summer field/practical intensive botany subject ('Flora of Victoria') online from my loungeroom to about a hundred students. No doubt, our regular work activities will be disrupted, at least episodically, for some time to come, and we will continue to find new ways of doing things.

In the midst of these difficulties, I tip my hat to Katharina Nargar and the team who are working toward our first ever online conference. Despite the great challenges, it probably also offers some novel opportunities and I can't wait to see what they come up with. I hope to see many of you there, and that it will be a great opportunity for us to catch up both botanically and socially.

Mike Bayly (email: president.asbs@gmail.com)

ABRS update – Flora, bryophytes, slime moulds, Bush Blitz news

ABRS abrs@environment.gov.au

Flora of Australia (FoA)

The Floras of Australia Working Group met in September 2020 to discuss the eflora profiles platform, content sharing and a potential model for a Floras of Australia. ALA will be undertaking an update of the software which will address a number of functionality issues currently experienced with the profiles platform. Watch this space.

While locked down and working from home for much of 2020, the Flora progressed. Recent Flora treatments include *Anthelepis* (Cyperaceae), Basellaceae, *Capillipedium*, *Dimeria*, *Sehima* (Poaceae), Corsiaceae, *Leptocarpus* (Restionaceae), *Persea* (Lauraceae), *Stellaria* (Caryophyllaceae) and revised editions of Aspleniaceae, Cactaceae, Musaceae, Nepenthaceae, Passifloraceae, *Platycerium* (Polypodiaceae), Podostemaceae, Urticaceae and Violaceae. There has also been major progress in updating parts of Anacardiaceae, Aquifoliaceae, Asparagaceae, Asteraceae, Burseraceae, Iridaceae, Onagraceae, Sapindaceae and Simaroubaceae. With assistance from John Busby we are in the process of adding to the eflora the endemic taxa from the Oceanic Islands *Flora of Australia* Volumes 49 and 50. Many thanks to all our Flora contributors and reviewers.

Flora contributions

Please contact the ABRS (email address above) with any feedback on *Flora of Australia* and *Bryophytes of Australia* content or platform functionality. If you would like to contribute new taxon profiles or update existing descriptions, please get in touch. This could include anything from adding complete treatments to adding profiles for taxa from your research papers. There is also much opportunity for updating and editing treatments loaded from the hard copy floras, including reconciling information with currently accepted taxonomic concepts.

Secretive Slime Moulds – Myxomycetes of Australia

To be released 1 March 2021, this new book by Steven Stephenson comprehensively describes Australia's 330 known species of myxomycetes and features numerous fascinating illustrations where nature rivals Dr Seuss creations. Edited by Tony Orchard and co-published with CSIRO Publishing.

Staffing

In September 2020, Haylee Weaver was appointed Manager of ABRS after acting in the position for most of that year. In January 2021 Haylee went on maternity Leave and from mid-February Zoe Knapp will be returning to ABRS as acting Manager in the interim.

In mid-January 2021, Dr Endymion Cooper joined ABRS as a Scientific Officer (Flora). Endymion specialises in the taxonomy and systematics of liverworts, and evolutionary biology of land plants and algae. He has held postdoctoral positions at the University of Maryland and Queen Mary University of London. His expertise will be a great addition to ABRS and the ongoing management of the *Flora of Australia* and advancing treatments in the *Bryophytes of Australia*.

Bush Blitz news

2020 was a challenging year for Bush Blitz, with a number of planned expeditions postponed at the last minute due to COVID. However, the Bush Blitz program learned to adapt to lockdowns by harnessing the interest of the public through a virtual Bush Blitz expedition called Backyard Species Discovery. The virtual citizen science project utilises iNaturalist to encourage all Australians to discover the plants and animals of

their own backyard. Backyard Species Discovery is pitched at the general public and schools with a series of lesson plans, videos, social media and competitions. In less than 12 months the project has accumulated approximately 130,000 records from over 2,700 members.

2021 is looking like a good year for Bush Blitz to be back in the field, with an expedition planned for the Stoney Head military training area in Tasmania in March, Groote Eylandt in the Northern Territory in June, and a 45 day marine Blitz with the *Investigator* also in June.

Grants

The 2021–22 National Taxonomy Research Grant Program (NTRGP) round closed on 18 December 2020. The evaluation process for applications is continuing, via the Community Grants Hub, and will be completed shortly.

Arcyria denudata, drawn by © Angela Mele, from Secretive Slime Moulds

Genomics for Australian Plants update

Lalita Simpson – GAP Research Community Project Manager – Australian Tropical Herbarium and James Cook University

Mabel Lum GAP Project Manager – Bioplatforms Australia

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

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 December 2020.

Reference genomes

Contributing teams are preparing publications for the reference genome pilot projects sequencing the genomes of *Acacia pycnantha* (golden wattle) and *Telopea speciosissima* (waratah). Contributing teams for phase two are preparing samples. Ms Stephanie Chen from the University of New South Wales and the Royal Botanic Garden Sydney presented her work on Assembling the waratah reference genome in an online seminar for the Royal Botanic Garden Sydney on Tuesday, 16 February 2021.

Phylogenomics

Phylogenomics (Australian Angiosperm Tree of Life [AAToL])

In Stage 1, the GAP phylogenomics project aims to reconstruct a genus-level Australian Angiosperm Tree of Life, sampling more than 95% of the nearly 2,100 native Australian angiosperm genera and targeting 353 low copy nuclear sequences with the Angiosperms353 target capture nuclear bait kit. Stage 1 of the project will be undertaken with the Plant and Fungal Tree of Life project (PAFTOL) that is working towards reconstructing a genus-level phylogeny of the world's angiosperms using the Angiosperms353 target capture nuclear bait kit.

Data generation for the GAP phylogenomics AAToL stage 1 is progressing well. Over 85% of the nearly 1,400 samples committed for Stage 1 have been submitted to the Australian Genome Research Facility (AGRF) and sequencing has been completed for 46% of these samples. The success rate for library preparation and sequence-read generation has been high, with AGRF able to generate sequence reads for 99% of AAToL samples processed so far. After delays due to COVID-19 restrictions, the Victorian team is again up and running and DNA extraction for the final 15% of samples is under way.

The AAToL stage 1 project is on track to generate sequence data for c. 1,370 Australian angiosperm genera and, through collaboration with PAFTOL, looks set to meet its aim of 95% coverage of the Australian angiosperm genera! Late last year, Principal Investigator of the PAFTOL project, Bill Baker, from the Royal Botanic Gardens, Kew, presented a talk for the Royal Botanic Gardens and

Domain Trust on Completing the Plant Tree of Life with Angiosperms353, which can be viewed here.

The GAP phylogenomics working group continues to meet regularly, including with the PAFTOL team, to manage and develop collaboration between the two significant and aligned programs. Preparations are under way for the next stage of data analysis which will utilise a streamlined bioinformatic workflow developed by the GAP bioinformatics working group. The workflow incorporates and improves existing bioinformatic tools in an efficient, easy-to-use pipeline to process sequence reads and recover loci, including resolution of paralog sequences. We are working with PAFTOL to establish the mechanisms to realise our intent to share data freely toward joint analyses and publications. Preparations are under way to release the call for expressions of interest for GAP phylogenomics AAToL Stage 2 later this year. Stage 2 aims to fill the tips of the Australian Angiosperm Tree of Life through production of target capture sequence data to generate phylogenomic datasets with denser sampling within genera to address questions of monophyly, evolution, and biogeography.

Conservation genomics

Sample collection and preparation are under way by contributing researchers for the conservation genomics project.

Bioinformatics training

Planning is under way to deliver hands-on training in the use of the bioinformatics pipeline developed by the GAP Bioinformatics working group for processing target sequence capture data. The workshops will be delivered in association with the ASBS conference. Due to uncertainties around potential COVID-19 restrictions, the bioinformatic training, like the conference, will be delivered virtually. The bioinformatics training will be delivered in collaboration with the Australian BioCommons and will be run in the week 5–9 July (the week preceding the conference which runs 11–16 July). A series of webinars and hands-on training sessions are being planned to outline strategies for analysing target sequence capture data from reads to trees, including paralogy resolution and detection of, and phasing of, hybrid accessions.

New appointment

Welcome to Dr Theodore Allnutt who has recently been appointed to the GAP bioinformatics team. Theo has over 20 years' experience in molecular biology research, bioinformatics and biological statistics. Theo has worked for the UK Government, European Commission, Universities and Research Institutes on a wide range of molecular biology projects, with over 50 peer review publications and 1,800 citations. Welcome Theo!

Acknowledgements

We would like to acknowledge the contribution of the Genomics for Australian Plants Framework Initiative consortium (https://www.genomicsforaustralianplants.com/consortium/). The Initiative is supported by funding from Bioplatforms Australia (enabled by NCRIS), the Ian Potter Foundation, Royal Botanic Gardens Victoria, Royal Botanic Gardens Foundation (Victoria), Royal Botanic Gardens Sydney, Department of Biodiversity, Conservation and Attractions, Western Australia, CSIRO, Centre for Australian National Biodiversity Research and Council Heads of Australasian Herbaria.

Eichler News

Marlies Eichler Research Fund Final Report

Bee F. Gunn

Royal Botanic Gardens, Victoria

Evolution of polyploidy in Australian Asparagales

Polyploidy is a major driving force behind the variation in plant nuclear genomes and can result in chromosomal duplications, gene duplications and deletions (Kellogg & Bennetzen 2004). It is estimated that up to 70% of flowering plants have experienced polyploidy during their evolutionary history (Masterton 1994). Extensive variation in genomic content (genome size) and chromosomal recombination following polyploidy may generate evolutionary novelties facilitating diversification (D.E.Soltis *et al.* 2009; P.S.Soltis & Soltis 2016).

Asparagales is a large order of monocots with economically important plants such as asparagus, onions, garlics, saffron and vanilla. It is currently recognised as comprising 14 families worldwide (Angiosperm Phylogeny Group 2016), some of which are also represented in Australia (10 fam.) and New Zealand (6 fam.). The Australian (non-Orchid) Asparagales [48 gen., ca. 327 spp.] are ecologically diverse and are also characterised by extreme morphologies, for example, in *Borya* (resurrection plants), *Bulbine* (rock lilies), *Lomandra* (mat-rushes) and *Xanthorrhoea* (grass trees). Three families, Blandfordiaceae, Boryaceae and Doryanthaceae, are endemic in Australia (George 1986, 1987), and Xeronemataceae is endemic in New Zealand and New Caledonia (Chase 2000). Cytotypes of several genera (*Bulbine*, *Crinum*, *Dianella* (blue flax lilies), *Lomandra*, *Stypandra* and *Xeronema*) that vary in ploidy levels have been documented (see Keighery 1984; Briggs 1986; Tamura 1995).

Polyploidy is documented in Lomandroideae (Gunn *et al.* 2020) and other Australian Asparagales (Briggs 1986). However, its prevalence is incompletely known and is in need of further investigation. *Lomandra* contains multiple species complexes with indistinguishable morphologies which are notable for presenting challenges for understanding species boundaries and relationships. For example, the three subspecies of *Lomandra filiformis* (*filiformis*, *coriacea* and *flavior* A.Lee) are difficult to distinguish from each other, having overlapping morphologies (leaf widths and inflorescence lengths). Knowledge of ploidy may help resolve these *Lomandra* complexes and infer their taxonomic relationships (Lee and Macfarlane 1986; Donnon 2009; Gunn et al. 2020). Flow cytometry has become the predominant method for estimation of absolute DNA content of cells and can also be used for estimation of ploidy, due to its high sample throughput and relative ease of sample preparation. Genome size is measured in picograms and refers to the amount of nuclear DNA per genome; ploidy level is the number of genomes in an organism. The 2C value corresponds to the DNA amount in a diploid organism. Absolute genome size is determined by using an internal reference with a published genome size (Doležel *et al.* 2007).

The absolute genome sizes of Australian Asparagales are poorly known (see Plant DNA C-values database). A fine-scale phylogeny of *Lomandra* based on plastome data has been generated and base chromosome number and ploidy have been reconstructed onto it (Gunn *et al.* in prep.). The results suggest that base chromosome numbers may be synapomorphic for the currently recognised clades. Thus, one of the aims of this project was to estimate the absolute genome sizes of all Australian genera of Asparagales. The second aim was to investigate the evolution of genome size and polyploidy across these genera within a phylogenetic framework based on plastome data from high throughput sequencing techniques (ABRS-funded project). Finally, the third aim was to doc-

ument morphological traits (seeds, leaves, flowers) that may be associated with genome size variation and polyploidy.

For flow cytometry, fresh leaf material was collected in the early morning and kept in the refrigerator. In order to estimate the absolute genome sizes of the specimens, various internal standards from published literature were used and chosen based on Doležel, Greilhuber and Suda, 2007. The main challenge of flow cytometry is the requirement for freshly collected leaf material for isolation of the nuclei (i.e., the availability of living plants of target species and internal standards).

Absolute genome sizes (in picograms; pg) were determined following established protocols (Doležel *et al.* 2007) and provision of internal reference standards from colleagues at CSIRO (Canberra). Flow cytometry techniques were carried out with multiple repeats for each sample. The absolute genome sizes across 9 families, 24 genera and 39 species of Australian Asparagales were estimated (*Arthropodium, Asphodelus, Astelia, Blandfordia, Borya, Bulbine, Caesia, Calostemma, Chlorophytum*, *Cordyline, Crinum, Cucurligo*, *Dianella, Doryanthes, Hypoxis, Lomandra, Molineria, Orthosanthus, Patersonia, Romnalda, Stypandra*, *Thelionema, Thysanothus* and *Tricoryne*).

During the project, absolute genome size estimates for only half of the proposed genera (24 of 48) could be estimated due to the difficulty in obtaining fresh leaf material for taxa from restricted areas in Western Australia because of allocated time constraints and limitations of field accessibility. Some taxa were challenging to locate in the field due to environmental and land use changes. For example, subsp. *flavior* of the *Lomandra filiformis* complex was last recorded from a restricted locality in inland New South Wales but could no longer be found growing there. Germination of seeds from herbarium vouchers was attempted but unfortunately without much success.

In 2018 (April–May), I supervised Kent Bennett (University of Melbourne), for an undergraduate research project where he generated some morphological and genome size data for the *Lomandra filiformis* complex. During January–February 2019, I trained and supervised Simone Currie under the Jim Willis Studentship program at the Royal Botanic Gardens Victoria, which provides students in their final year of undergraduate study the opportunity to conduct taxonomic-focused research. Simone participated in a study that investigated relationships among morphological and anatomical variation, chromosome numbers, and genome sizes in the *Lomandra filiformis* complex (subspp. *filiformis*, *coriacea* and *flavior*). Morphometric characters were scored from herbarium vouchers, chromosome counts were obtained from root tips and stomata measurements from epidermal leaf peels were studied under light microscopy.

A highlight of the *Lomandra* complex study, made possible by support of the ASBS Marlies Eichler Postdoctoral Fellowship, was finding a relationship of genome size, stomata size (mean guard cell lengths), stomata density and chromosome number. *Lomandra filiformis* subsp. *filiformis* is a polyploid (2n = 28–32) with genome size twice that of subspecies *coriacea* (2n = 14) and its stomata size was significantly larger than that of subsp. *coriacea*. Stomata aperture is regulated by the length of the guard cells which in turn is determined by the genome size (Woodward 1998). Few studies have tested the relationships of genome size with cell size and stomatal density (Beaulieu *et al.* 2008) and genome size with stomata (Hodgson *et al.* 2010). A possibility in the future is using stomatal measurements to understand the relationships of cell size and polyploidy in other genera of Asparagales.

Another outcome of the project was the provision of absolute genome sizes of Australian Asparagales at the familial, generic and specific levels, many for the first time. This includes Boryaceae, an early diverging

lineage of Asparagales, with several endangered species such the *Borya mirabilis* Churchill (Reiter, Walsh & Lawrie 2015) and *B. stenophylla* M.D.Barrett.

Results indicate that the genomes of Australian Asparagaceae are amongst the smallest in the order, consistent with genome size comparisons reported from previous studies across Asparagales worldwide (Pires *et al.* 2006). Flow cytometry data provide evidence for polyploidy in *Arthropodium minus*, *Bulbine glauca*, *B. vagans* and *Lomandra filiformis* subsp. *filiformis*.

A manuscript is in preparation based on the findings of genome size and polyploidy in Australian Asparagales with an emphasis on *Lomandra*. This genome size dataset will form the basis for a further study to reconstruct the ancestral genome size of the Australian Asparagales on a molecular phylogeny.

I am very thankful to the Australasian Systematic Botanical Society through the Marlies Eichler Postdoctoral Fellowship grant for enabling me to apply flow cytometry techniques to estimate absolute genome sizes to investigate genome size evolution in the Australian Asparagales. The fellowship also created opportunities to me to train and mentor two final-year Science students and to extend my contribution to the project funded by the Australian Biological Resources Study (ABRS) on 'Resolving the Australian Asparagales classification and *Lomandra* taxonomy using phylogenomic techniques' (PI: Joanne L. Birch and Co-PI: Daniel Murphy).

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On page 12:

Photo 1: *Bulbine bulbosa* (Asphodelaceae), Mt Painter Nature Reserve, Australian Capital Territory; Photo credit: Michael Gunn.

Photo 2: *Lomandra filiformis* subsp. *filiformis* (Asparagaceae), female plant in fruit, Mt Painter Nature Reserve, Australian Capital Territory; Photo credit: Michael Gunn.

Photo 3: *Lomandra filiformis* subsp. *coriacea* (Wattle mat-rush) (Asparagaceae), female plant in fruit, Mt Painter Nature Reserve, Australian Capital Territory; Photo credit: Michael Gunn.

Photo 4: *Crinum pedunculatum* (Swamp lily) (Amaryllidaceae), Cairns, Queensland. Photo credit: Bee F. Gunn.

Photo 5: *Stypandra glauca* (Asphodelaceae), Aranda Bushland Nature Reserve, Australian Capital Territory; Photo credit: Michael Gunn.

Photo 6: *Astelia australiana* (Asteliaceae), Victoria; Photo credit: Neville Walsh, Royal Botanic Gardens Victoria.

Photo 7: *Blandfordia grandiflora* (Christmas Bells) (Blandfordiaceae), Noosa Heads, Queensland. Photo credit: Bee F. Gunn.

Photo 8: *Patersonia occidentalis* Iridaceae, Perth, Western Australia. Photo credit: Bee F. Gunn.

Photo 9: *Borya mirabilis* (Pincushion lily) (Boryaceae), The Grampians, Victoria; Photo credit: Neville Walsh, Royal Botanic Gardens Victoria.

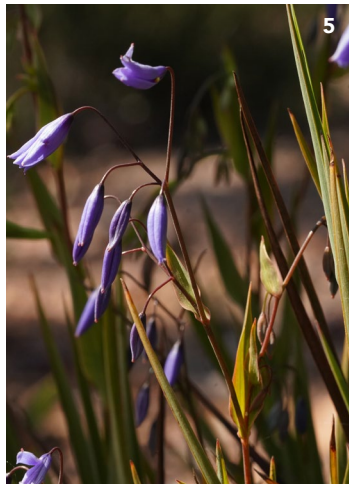
Exemplars of families of Asparagales sampled for genome size estimation

Bulbine bulbosa

Lomandra filiformis subsp. *filiformis*

Lomandra filiformis subsp. *coriacea*

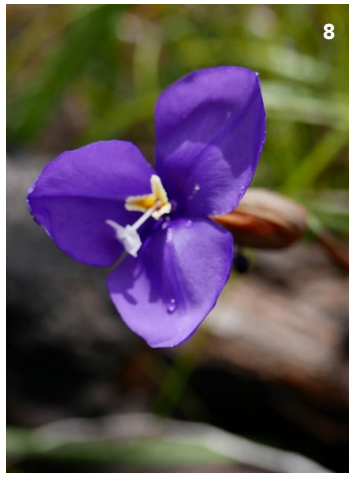
Crinum pedunculatum



Stypandra glauca

Astelia australiana

Blandfordia grandiflora



Patersonia occidentalis

Borya mirabilis

Marlies Eichler Postdoctoral Fellowship Report

Phylogenomics & Taxonomy of the donkey orchids (*Diuris*, Orchidaceae)

by Lars Nauheimer

In 2018, I was fortunate to be awarded a Marlies Eichler Postdoctoral Fellowship and used it to top up my postdoctoral research grant provided by the Australian Biological Resources Study (ABRS) to investigate the evolution of donkey orchids (*Diuris*). The project was designed to be completed over three years, including two years of employment for myself as postdoc at the Australian Tropical Herbarium in Cairns. Thanks to the financial support attached to the Fellowship, I was able to extend the period of my employment for additional four months on a part-time basis. This extension proved to be very useful as the project experienced several delays. Here, I report on the progress of the project and preliminary results.

Orchidaceae is among the ten largest plant families in Australia and contributes a large proportion of Australia's threatened flora due to the narrow distributions of many species. The taxonomy of Australian orchids is very dynamic: 40% of species had been described in the last two decades (Jones 2006, Hopper 2009, Backhouse *et al*. 2019) and authors of orchid checklists often disagree on taxon concepts (e.g. Backhouse *et al*. 2016 and Govaerts *et al*. 2017 list 1,355 and 1,402 species, respectively, but 238 species are listed in one list but not the other). Resolution of taxonomic concepts in Orchidaceae is key for developing efficient conservation measures in this highly-threatened family, and recent advancements in phylogenomics offer new opportunities for this. In this project, we aim to apply new phylogenomic methods to resolve the taxonomy of the orchid genus *Diuris*.

Diuris is the fifth largest orchid genus in Australia, comprising c. 100 species of which 35 are listed as priority flora in Australian States. Taxonomically, *Diuris* is notoriously complex. More than half of *Diuris* species have been described in the last 30 years, but recent checklists disagree on taxonomic concepts; Kew's World Species Checklist and Backhouse *et al.*'s (2019) checklist both name 98 *Diuris* species, but 12 are listed in one but not the other.

Species delimitation is particularly challenging in *Diuris* due to their high morphological variability and tendency to hybridise. This is thought to be driven by the food mimicry pollination strategy in *Diuris*; many *Diuris* species attract pollinators by resembling nectar-bearing pea flowers without actually providing any nectar reward (Indsto *et al.* 2006, 2009, Scaccabarozzi *et al.* 2018). The high floral morphology variability in some *Diuris* species is thought to enhance the efficacy of this pollination strategy by improving the chance of mimicking a co-occurring pea flower. The food mimicry pollination strategy also attracts a wide-range of pollinators and can lead to cross-pollination between co-occurring species and hybridisation. Indeed, hybridisation is prominent in *Diuris*, with 48 hybrids recorded, many of which have parents from different sections or even subgenera (Backhouse *et al.* 2019). Thus, because of the food-mimicry pollination strategy, high morphological variability is maintained, making taxonomic delimitation particularly challenging.

Phylogenetic studies in *Diuris* based on Sanger sequencing and AFLP fingerprinting resolved clades only at a subgeneric level, and relationships of sections or species remained largely unclear due to shallow divergence between species (Smith *et al.* 2005, 2007, Indsto *et al.* 2009). They also revealed incongruences between nuclear and plastid phylogenies, indicating hybridisation in parts of the genus (Smith *et al.* 2005, 2007). A recent

study on an endangered species complex of *Diuris* in Victoria applied the next-generation sequencing approach RADseq and was able to resolve species boundaries for which morphological characters were insufficient (Ahrens *et al.* 2017). This demonstrated the need for phylogenomic methods to investigate the evolution of this challenging genus.

In this ABRS-funded and ASBS-supported project, we (Mark Clements (CANB), Katharina Nargar (CSIRO), Darren Crayn (ATH) and I), aim to clarify species delimitations, resolve species relationships and reconstruct reticulation events using various next-generation sequencing methods and novel bioinformatic approaches. Firstly, a genome skimming approach resulting in the recovery of plastid genes or whole plastomes as well as the nuclear rRNA-array will provide a strong framework for assessing species relationships and insights into reticulations of the genus. It will further be a basis for sampling of a more in-depth target capture sequencing analysis, which uses a previously established capture probe developed for Diurideae targeting 473 nuclear genes including introns. The target capture dataset will be used to establish a thorough genus-wide phylogeny inferring species relationships. Recently developed bioinformatic workflows will then be used to detect hybrid accessions and reconstruct reticulations in the evolutionary history of the genus. Based on this phylogenomic framework and a morphological data set for *Diuris*, ancestral trait evolution will be reconstructed to identify key diagnostic characters within *Diuris*. Finally, population genomic analyses will be carried out for selected species complexes based on double-digest restriction site associated DNA sequencing (ddRADseq) to assess species delimitation, and the conservation status of threatened species within these complexes. The results of the phylogenomic and morphological project components will underpin a revised taxonomic treatment of *Diuris* for the *Flora of Australia*.

To date, the majority of sampling from herbarium vouchers and floral cards has been completed; however, the collection of fresh material to complement the existing samples has been impeded by drought. The extremely dry conditions in winter and spring of 2018 and 2019 led to poor flowering seasons for most *Diuris* species that rely on rainfall during these times. We first postponed and then cancelled the fieldwork campaign that aimed to provide samples for the population level study. Fortunately, local collaborators were able to collect samples from a few flowering populations and we could increase our sampling together with herbarium vouchers to 476 accessions, representing almost all species and five hybrids. Due to the lack of silica-dried samples (which are required for the ddRADseq approach), we changed the methodology for the population-level study of species complexes to target capture sequencing. Although this means that fewer samples can be included due to higher sequencing costs per unit, it will allow combining the population sampling with the genus-wide dataset and lead to improved analysis of reticulations that might play an important role in species complexes. DNA extractions for the project were carried out and miniaturised genomic libraries were prepared for genome skimming and sequenced, which was supported by CSIRO's Environomics Future Science Platform. In total, 131 samples of 80 *Diuris* species and two hybrids as well as one outgroup sample were sequenced and assembled to recover 77 plastid genes and spacer as well as the nuclear rRNA array (ETS-S25). Phylogenetic analyses provided insights into species relationships, sectional and subgeneric classification and reticulations.

All subgenera were monophyletic with highest support in plastid and nuclear phylogenies, confirming previous studies (Indsto *et al.*, 2006, 2009). For the first time the relationships between the subgenera were resolved with high support but with conflicting topologies from both dataset in relation to the subgenus *Palustre*. In the nuclear dataset *D. palustris* was sister to subgenus

Hesperodiuris, while in the plastid dataset it was sister to a clade consisting of the subgenera *Hesperodiuris*, *Diuris* and *Xanthodiuris*. In contrast to the subgenera, almost all sections were non-monophyletic. Only section *Suffusae* and *Pyrophilae* were recovered as monophyletic in the plastid and nuclear phylogenies, while all other sections comprised multiple divergent clades or had taxa grouping with taxa from other sections. Although all taxa from the section *Hesperodiuris* grouped together, the clade also included two taxa assigned to section *Setaceae*, *D. eburnea* and *D. picta*. The remaining taxa from section *Setaceae* formed two divergent clades with different sister relationships in the nuclear and plastid datasets. The section *Pedunculatae* consisted of two clades that did not contain taxa from other sections. One clade contained *D. pallens, D. subalpina* and *D. lineata* grouped with the other sections of the subgenus. Taxa from the sections *Diuris* and *Purpureo-alba* were found to group together in multiple clades, as were taxa from the sections *Abbreviatae* and *Xanthodiuris*. In addition to the highly non-monophyletic sections, we found that several taxa were not monophyletic. The dataset contained 42 taxa with multiple accessions, of which accessions from 16 taxa in the plastid and nine in the nuclear dataset did not group together. Many more species relationships were not resolved due to low phylogenetic divergence between taxa. It is also noteworthy that the branch lengths inside the sections and even between some sections were much shorter compared to the branches between the subgenera, which is especially prominent in the nuclear phylogeny. The low divergence could have originated through rapid radiations, inappropriately narrow species concepts, or hybridisation of closely related taxa. Further signs for reticulation was found in the comparison of plastid and nuclear phylogenies, which revealed topological incongruences across the whole genus including relationships of many species, sections and even subgenera. This widespread and deep discordance between the datasets could have originated through recent hybridisations or the existence of polyploid lineages. Hybridisations even between taxa from divergent lineages have been reported and chromosome counts further support the existence of polyploids (Dawson *et al.* 2006).

The insights from the genome-skimming analyses in regards to non-monophyly of sections and species led to re-evaluation of sampling for the combined target capture analysis for the genus-wide phylogeny and the population-level analysis of species complexes that had been delayed through the cancellation of fieldwork. Further delays to the target capture sequencing were experienced due to the outbreak of the COVID-19 pandemic, and the discontinuation of the target capture chemistry (NimbleGen) that was needed for the custom Diurideae probes in mid-2020. Fortunately, the design of the probes (completed by Rod Peakall's lab at ANU) is soon to be submitted for publication and available for redesign. This probe redesign is needed for other projects of our team focusing on taxa of Diurideae and is planned in early 2021 using the Mybaits probe kit from Arbor Biosciences.

Lastly, the extent of topological conflict between the nuclear and plastid genome skimming analysis indicated that the detection of hybrid samples and reticulations would be crucial for understanding the evolution of *Diuris*. A bioinformatic workflow that I developed to investigate reticulation in sun orchids (*Thelymitra*) was refined for use on the *Diuris* target capture data. This workflow, HybPhaser, extends the application of the assembly software HybPiper with the detection and phasing of hybrid accessions. It can be used to identify parental lineages of hybrids and reconstruct reticulated evolution in target capture datasets. The workflow has been published as pre-print on bioRxiv (Nauheimer et al. 2020) and made available for download on GitHub (www.github.com/LarsNauheimer/HybPhaser). We are looking forward to applying HybPhaser to the *Diuris* target capture dataset to unravel the importance of hybridisation for evolution of the

genus and improve the taxonomy of these fascinating and beautiful plants.

I am very grateful to ASBS for the Fellowship. It enabled the extension of my employment and allowed me to invest more time into the project. I am also thankful for my colleagues Mark Clements for the tremendous sampling efforts, and Katharina Nargar and Darren Crayn for their constant support and work on the project.

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Diuris alba, Munmorah, N.S.W. Photo: Mark Clements

Diuris concinna, Helms Arboretum, W.A. Photo: Lars Nauheimer.

Diuris longifolia, Albany, W.A. Photo: Lars Nauheimer.

ASBS Hansjörg Eichler Scientific Research Fund – deadline 15 Mar 2021

The next round of the ASBS Hansjörg Eichler Scientific Research Fund applications is due on Monday, 15 March 2021. This is a generous scheme providing up to $5,000 for research projects. All current ASBS members are welcome to apply, with preference given to students, recent graduates, newly-established botanists and non-salaried researchers.

Guidelines, essential criteria and application forms are available here: http://www.asbs.org.au/asbs/hesrfund/index.html

Please share with your networks!

Nancy Burbidge Medal

Please also note that Council welcomes nominations for the 2021 Nancy Burbidge Medal. Please see the details required on the ASBS website: https://www.anbg.gov.au/asbs/burbidge.html.

Herbarium News

News from the National Herbarium of New South Wales

Hannah McPherson

While last year brought with it a lot of disruption and many challenges (as it did for all), the construction of the new building for the National Herbarium of New South Wales has remained on target. Construction began in August 2020 and by January this year it really started to take shape. The northern and southern building slabs have been poured, the wet collection room and loading dock structures are in place and the fly roof is currently being installed. In December several Herbarium and other Science staff from the Royal Botanic Garden Sydney took the opportunity to explore the new Herbarium building construction site.

One of our major goals before moving is to digitise the herbarium collection – a massive undertaking that will provide valuable data for planning and implementing the move as well as an amazing public resource. In December we celebrated reaching 500,000 high-resolution digital images captured as part of our digitisation project. This includes all the lichens and bryophytes and some big plant families including Lamiaceae, Proteaceae, Fabaceae and Orchidaceae. After a pause in imaging and suspension of volunteer programs last year due to COVID, this milestone felt all the sweeter. The success of this project is shared by the many teams and collaborators that support this project including digitisation, Picturae, volunteer coordinators, herbarium curators, botanists and many more. We are also very happy to see the return of volunteers to the herbarium this year.

In the year ahead we will focus on finishing the digitisation of the collection and preparing to move to the new facility towards the end of the year. Thank you to all for your patience with us during this time.

Back row (L to R): Hannah McPherson, Wayne Cherry, Kristina McColl, Jude Wright, Margaret Heslewood, Peta Hinton

Front row (L to R): Carolyn Connelly, Zonda Erskine

Construction of the fly-roof for the new Herbarium. Photos: courtesy of Hannah McPherson.

News from the Western Australian Herbarium

PERTH is still basking in the glory of 2020's 50th birthday celebration of the Herbarium journal *Nuytsia*, publishing volume 31 in which 50 new species were described over the course of the year, accompanied by a social media blitz. The prime movers of this project, Juliet Wege and Kelly Shepherd, plus all the PERTH botanists who contributed, can be justly proud of this achievement, which was several years in the planning. A palpable sense of pride, but also some relief, was felt by all when the final paper was released in late November.

Staff from the WA Herbarium are working closely with DBCA Senior Research Scientist (Plant Genetics) Rachel Binks on four Genomics for Australian Plants (GAP) Conservation genomics projects (https://www.genomicsforaustralianplants.com/conservation-genomics/). These projects got off to a great start with all field work and in-house DNA extraction completed for projects on *Geleznowia* (Kelly Shepherd) and *Wurmbea* (Terry Macfarlane) before Christmas, and *Synaphea* (Ryonen Butcher) and *Isopogon* (Barbara Rye) by early January. Samples were sent to AGRF for sequencing and results are already available for the first two projects with the rest soon to follow… now the arduous process of analysing these data begins!

Herbarium Identification Botanist Rob Davis and Research Associate Tim Hammer have been working on a new species of *Ptilotus* from the north-west Kimberley, which should be published soon. Rob has also discovered a new species of *Swainsona* from Karara Station in the Yalgoo bioregion, from a mining survey.

Curator John Huisman is continuing his studies on the local marine algae and has recently collected specimens of several species of filamentous red algae that were described by Irish botanist W.H.Harvey in 1855 but have remained poorly known since that time. Several new taxa and combinations are likely outcomes.

New species descriptions in *Tephrosia* (Fabaceae: Millettieae) are coming thick and fast, with two papers recently submitted as part of an ABRS NTRGP grant towards revising the genus in Western Australia and the Northern Territory. In one, Ryonen Butcher describes two new species from the Kimberley region, and in the second she pairs with Ian Cowie (DNA) to describe two new widespread species (WA, NT, Qld) allied to *T. supina* Domin, the true identity of which is finally revealed.

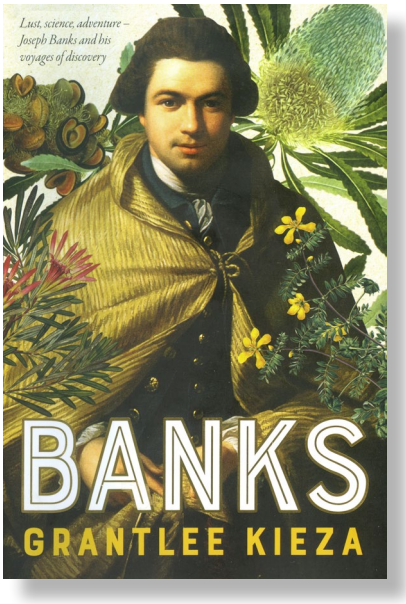
In the Collections Team, Shelley James collaborated with the Department of Agriculture, Water and Environment, DPIRD and Parks Australia to undertake a weeds survey of Christmas Island and the Cocos (Keeling) Islands in November 2020. The PERTH collections team is actively updating the geocoordinates of collections, primarily targeting the localities of priority taxa to assist with conservation efforts.

John Huisman, Curator (PERTH)

Book Reviews

Joseph Banks – lusty, notorious adventurer or botanical mastermind?

Book review by Tony Orchard



Banks

Grantlee Kieza

ISBN 978 0 7333 4050 5 (hardback)

245 x 160 mm

HarperCollins Publishers in association with the ABC, 2020, 485 pp.

RRP $39.99

The cover blurb describes this book as 'Lust, science, adventure – Joseph Banks and his voyages of discovery', and on the back cover: 'The extraordinary life of one of the world's most famous and notorious adventurers'. This fully justifies the old maxim of not judging a book by its cover. I was hard pressed to discover much lust – some youthful dalliances, two, possibly three mistresses (including Oborea, a Tahitian Queen), a possible illegitimate child, and a couple of fiancées, one of whom he jilted, just about covers it, a pretty modest total by the standards of the day for a very rich bachelor (until he married in 1779). Only about half the book is concerned with his voyages, the rest deals with his life in England. 'Notorious' hints at criminal wrongdoing, which is nowhere implied in the book. While Banks was from time to time mocked in pamphlets and cartoons, so were many other important contemporary personages. The 'tall poppy' syndrome was alive and well in 18th century Britain. These advertising tricks actually do the book a disservice – it is a comprehensive and well written biography, thoroughly researched and pretty well balanced, and can stand on its own merits without hyperbole.

There have been many books on Banks, among the best known being Lysaght (1971), Lyte (1980) and Carter (1988), and this one clearly draws on what has gone before it. It follows the usual format for a biography. After a short Protologue (beginning with one of the few instances of the author inserting Banks' thoughts into the story 'Joseph Banks took a deep breath and looked nervously to the coast of what would one day be called Australia…') the story begins with a short description of Banks' parents and grandparents, their marriages, wealth and social position.

Chapters 2 and 3 describe Joseph Banks' schooling at Harrow, Eton and Oxford University. As has been described elsewhere, Banks was a very poor pupil, seeing little need for the obligatory Latin and Greek, and in fact was not even particularly good at writing or arithmetic. His wealth helped him get a university place, where he serendipitously discovered botany. As Oxford could not provide a botanical education at that time, he personally engaged a tutor from Cambridge, who laid the foundations for Banks' enduring interest in plants.

Chapters 4 and 5 deal with Banks' first major expedition, to Labrador and Newfoundland with his friend Constantine Phipps. In this chapter, as in most others, the author provides contemporary descriptions of the life of Cook, as well as vignettes of many other

major social and political figures, including John Montagu, 4th Earl of Sandwich, who facilitated many of Banks' expeditions through his influence with the Admiralty.

Subsequent chapters deal with his election to various important scientific and philosophic societies, his machinations to join Cook's first voyage, and his adventures with him in Brazil, Tahiti, New Zealand and Australia. The description of the stop in Rio de Janeiro in 1768 is particularly interesting. The Portuguese Governor suspected the *Endeavour* of being a spy ship and refused permission for anyone but Cook to land. Banks managed to sneak ashore for some quick collecting, but the incident rankled with him. Nearly 50 years later, when the Portuguese were under British hegemony after the transfer of the Portuguese court to Rio to escape Napoleon, Banks had his revenge, sending Allan Cunningham and James Bowie to Rio for two years to collect for Kew (Orchard & Orchard 2015). There is probably little in these chapters that is new to those who have read previous biographies, but the writing is clear, concise and full of detail, providing a very useful chronology.

The description of the lead up to Cook's second voyage is particularly interesting. An over-confident Banks insisted on taking a greatly enlarged entourage with him, necessitating the addition of a massive superstructure, so top-heavy that the ship's captain refused to take the ship to sea. In a fit of pique, Banks withdrew from the expedition. When the ship reached Madeira, Cook heard of a 'Mr Burnett', apparently a woman dressed as a man, who had been waiting to join the ship – presumably another of Banks' lady friends. He/she left the island abruptly just before Cook arrived, upon hearing that Banks was not on the ship.

In Chapters 19 and 20 we read of Banks' lobbying for Botany Bay as a colony for convict transportation, and of his success when rival suggestions for colonies in Africa proved fatally untenable. In these chapters Banks meets and marries his wife Dorothea and gives up his voyaging and adventuring. He settles instead to be a lobbyist, drawing on his influence and friendship with most of the leading political and governmental identities of Britain, and in particular his close friendship with King George III, and later, the Regent. Wisely, Banks studiously avoided affinities with any particular political group, finding he could have greater influence as a free-lancer.

Chapters 21 to 23 have little about Banks, describing instead the appointment of Arthur Phillip as first Governor of New South Wales, his voyage to Australia, and a brief description of the first years of the colony, extending to William Bligh, the mutiny on the *Bounty*, Bligh's disastrous term as Governor, and the malign influence of John Macarthur. During this period Banks was engaged in arranging the smuggling of merino sheep out of Spain, to the later benefit of the British and Australian wool industries.

Chapters 24 and 25 covering the period from 1801 to 1820, a quarter of Banks' life, appear to have been greatly compressed. In these chapters are a very brief discussion of Flinders' voyage, and the activities of George Caley, William Paterson, George Suttor, George Bass, Robert Brown, Ferdinand Bauer, Allan Cunningham and James Bowie, all of which were arranged or overseen by Banks. It appears to this reader that the book was either getting too long, or needed to be finished in a hurry, and this period, by far the most productive period for Banks' botanical missionaries, suffered in the process. The efforts of Brown and Bauer in New South Wales after the departure of Flinders are described in a single page, while Allan Cunningham's 14 years collecting for Kew under Banks' direction also merits only a page (and then, his expeditions to Timor (twice), Mauritius, New Zealand (twice) and Norfolk Island are not mentioned). This is a pity. In several places in the book, the author states that botany was one of Banks' driving passions, yet those he sent collecting on his

behalf, and whose specimens underpin many more Australian plant names than his own, are given only passing mention.

There is one other problem with this book, and that is entirely attributable to the publisher. On the reverse of the title page there is a long statement about the paper used being natural, recyclable and from sustainable plantation forests (its archival quality is not stated). The result is a rough page texture, yellowish in colour resembling an airport novel, which has resulted in the many black and white text figures often being little more than black blobs. There is a central block of colour plates, printed on surfaced paper, which are of high quality. It is a pity better-quality paper was not used throughout, as this book will undoubtedly be used as a quality reference for years to come. And while speaking of the plates, note that on p. 202 the illustration of the *Endeavour* beached in the Endeavour River is a mirror image of the original.

In summary, this is a comprehensive biography of a man very important to both Australian history and botany. It has been thoroughly researched, as shown by the thick peppering of footnotes throughout. These are both explanatory and referential. There are 2,055 of these, or an average of over 5 per text page. The writing throughout is tight, concise, factual and very easy to read. The narrative flows well, although there is a fair bit of jumping backwards and forwards chronologically, often unavoidably. The story of Banks is set very firmly within the context of his times, with much background information on persons and contemporary events. Inevitably, some incidents or events are glossed over or omitted. The author states that Banks sent or received over 100,000 letters in his lifetime, and he was very active as a lobbyist for many branches of science, agricultural reform, diplomacy and other aspects of life, including, towards the end of his life, the abolition of slavery. It would take several volumes to adequately discuss all of his achievements – the author has done well to provide a smorgasbord.

I heartily recommend this book to those looking for an excellent summary of Banks' life and achievements. A note about the price: the price from 'good bookshops' is about $40, but if you shop around it can be found for several dollars less. Ordering direct from HarperCollins allegedly gets it down to about US$11 with free shipping if you order other products to the value of US$49. However, even at $40 it is a bargain.

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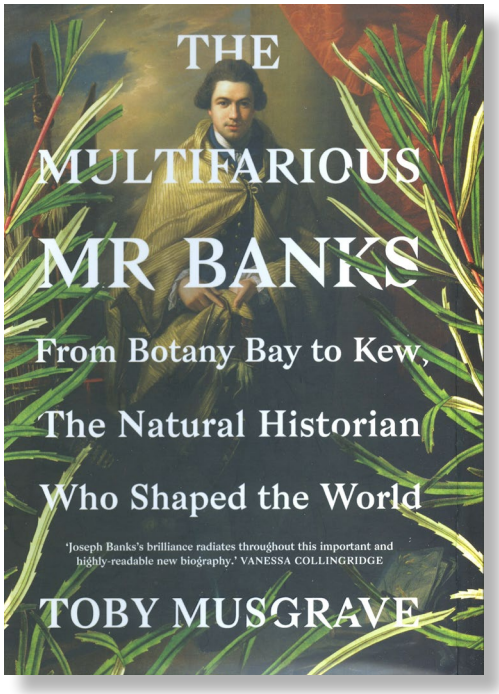
Yet more Banks

Commentary by Alex George



At first glance it might appear a curious coincidence that two new biographies of Joseph Banks have appeared in the same year, but it is perhaps not coincidental in that 2020 was the bicentenary of his death. Above, Tony Orchard reviews that by Grantlee Kieza. The second is

The Multifarious Mr Banks: From Botany Bay to Kew, The Natural Historian Who Shaped the World

Toby Musgrave

ISBN 978-0-300-22383-5 (casebound) 223 × 160 mm

Yale University Press, New Haven, London, 2020, pp xvii, 368

Price $52.00

I have read both books and, in my role as assistant editor for this *Newsletter*, I have had the benefit of reading Tony's review of Kieza's book. Since he covers the salient details of Banks' life, I will not repeat those here but focus on particular aspects of Musgrave's book and make a few comparisons.

Kieza lists Musgrave's book in his bibliography (and acknowledges him) so clearly that was published earlier. Musgrave does not mention Kieza. While both document the same life and activities, the emphasis is different. Musgrave structures his account by emphasis on particular subjects (e.g. Banks' involvement with Kew, Merino sheep, various societies), whereas Kieza follows a more strictly chronological story.

In general Musgrave's succinct summaries of activities undertaken and supported by Banks are appropriate in the context of a biography but one topic is too abbreviated: the Flinders voyage of 1801–03. After reaching Cape Leeuwin the only event noted is the meeting with Baudin at Encounter Bay. There is no mention of the survey of the east and north coasts, except a note in the Introduction where he refers incorrectly to the 'first' Flinders circumnavigation. It is also wrongly implied that Good died when they reached Sydney in 1802, and the date of his death is wrong, given as 19 June when in fact it was 13 June 1803.

Musgrave places Banks very well in his times, prevailing customs, morals, social mores, economics and scientific development. One of his driving passions was to make Kew the greatest botanic garden of its day, an ambition in which he succeeded handsomely. Musgrave perhaps handles this topic better than Kieza, who was more concerned with other aspects of Banks' activities.

Musgrave also gives a better account of Banks' skills in dealing with government bureaucracy (sometimes made more challenging due to frequent changes in personnel, restructuring etc. – sound familiar?). By refraining from taking a political office, Banks was able to liaise with all sides. He emphasises Banks' role in supporting exploration, scientific research and colonial expansion, especially in relation to the estab-

lishment of the colony in New South Wales and its subsequent development. In his mind always was the benefit to Britain scientifically, commercially and politically. On the matter of the cost to Banks of the *Endeavour* voyage (usually given as £10,000), Musgrave's analysis sets it at around £6,000.

Musgrave has been careful with scientific names, the one rare error being the suggestion that a tree yielding gum at Botany Bay might be *Eucalyptus alba*. He refers to specimens being 'harvested' and then mounted as herbarium sheets. The latter did not happen until much later, in London.

Musgrave's style is consistent, easily read and occasionally lightened by an aside. For example, when it was proposed to get Merino sheep from Spain (which prohibited their export), Banks wrote that 'speculation was instantly and carefully begun', to which Musgrave adds '(a polite way of saying that a plan was hatched for heist and smuggling)'. Kieza's account of how merinos were acquired by various British interests is also quite detailed.

A few quibbles

Some important references are not cited so presumably were not seen by either author, e.g. D.J.Carr, The books that sailed with the *Endeavour*, *Endeavour* (n.s.) 7: 194–201 (1983); D.J.Carr (ed.), *Sydney Parkinson: Artist of Cook's* Endeavour *Voyage*, ANU Press (1983); all the Orchards' volumes on Allan Cunningham; and K. Mills, *Allan Cunningham: Journal of a Botanist on Norfolk Island in 1830*. (Coachwood Publishing: Jamberoo).

A few further random observations on Musgrave's account: Plate 33 in Musgrave is the painting by Joshua Reynolds of the Society of Dilettanti at a meeting in January 1777. In the caption, Banks is correctly noted as the figure on the right; in the text (p. 313) he is said to be on the left. I suspect that George Bentham might not appreciate being called a horticulturist (p. 311). Robert Brown is said (p. 333) to be 'better remembered for his description of Brownian motion'— this is not so in Australia, and he was rightly famous throughout Europe as a taxonomic botanist. The leafy sprays of *Banksia* superimposed on the portrait on the cover of Musgrave are probably *Banksia spinulosa* var. *cunninghamii* which Banks and Solander did not collect. It would have been more appropriate to use one of theirs.

The page and type size are similar in each book and it is interesting to compare the endnotes (Musgrave 12 pp, Kieza 53 pp), bibliographies (Musgrave 7 pp, Kieza 5.5 pp including internet resources) and indexes (Musgrave 10 pp, Kieza 13 pp).

Comparison of the indexes would make a good topic for one so inclined. Neither is ideal. A number of lesser characters are missing, e.g. the Kew gardeners George Austin and James Smith, Joseph Foveaux, even Peter Good. 'Endeavour River' is missing from both, but Musgrave has a main entry 'Botany Bay' and a subentry for it under '*Endeavour* voyage of discovery'. Few plant names are indexed.

Strangely, Kieza has no contents page, hence the only way into the text (apart from reading it) is through the index. A contents page would have been easily generated, as each chapter has an informative heading. The format of the bibliography is also unusual: authors are in alphabetical order of family names but each is preceded by the full given name(s).

Other comments

Several historical errors commonly seen in writings about Banks and the *Endeavour* voyage persist in both these works. The ship was HMB, not HMS (Musgrave even has a chapter headed HMS *Endeavour*). Musgrave also calls King's ship HMS *Mermaid*. It was an uncommissioned naval ship and hence was HMC (His Majesty's Cutter), as carved by the crew on a Boab at Careening Bay in 1820.

At that period the gardens at Kew were called the Royal Gardens, not Royal Botanic Gardens—the latter name dates from 1841 when they became a public institution under the directorship of William Hooker. Musgrave discusses this in an endnote (no. 14, p. 342) but in the text seems undecided and even makes a 'correction' to a quote from Banks (p. 252) by inserting [Royal]. In an account of journeys in southern Africa in 1772–74, Francis Masson used the name Royal Botanical Gardens but unofficially. Likewise, Musgrave discusses the name of the Linnean Society but tends to spell it 'Linnaean', having a section of chapter 8 headed The Linnaean Society.

Banksia was published by the younger Linnaeus in 1782, not 1781, an understandable error since 1781 appears on the titlepage, but the relevant page did not appear until 1782 (Musgrave in fact implies that year on p. 295). Because Linnaeus named three species from Botany Bay, it has usually been assumed that they collected only those three there, but, in fact, there is a specimen of *Banksia robur* also collected there by Banks at BM. There is (or was in the 1970s) a small population of this species within walking distance southwards from the bay.

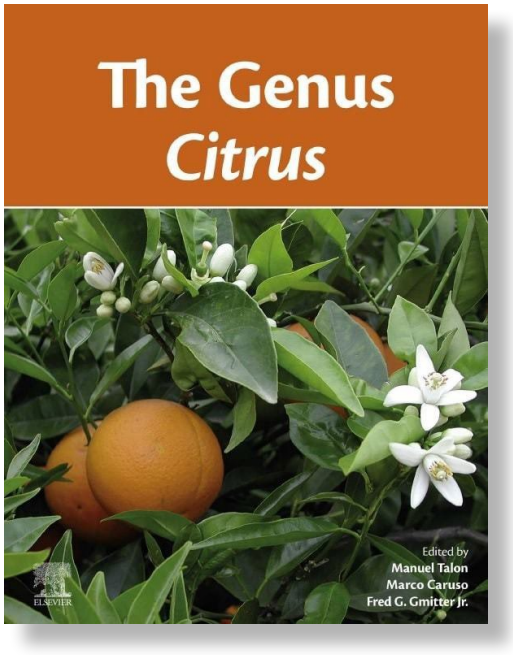
A thorough comparison of these two books would take some time. Suffice to say here that both are very good. My suggestion is to read *both* books.

The Compleat Citrus?

Review by David Mabberley, Sydney and Oxford

***The Genus* Citrus**

By Manuel Talon, Marco Caruso, Fred Gmitter, Jr. (eds)



Woodhead Publishing (Elsevier), Duxford, UK; Cambridge, Massachusetts; Kidlington, UK, 2020, xv + 521 pp.

ISBN 978 0 12 812163 4, e-ISBN 978 0 12 812217 4

$US 315.00 [eBook $US 315.00]

The appearance of a second *Citrus* compendium in 2020 (see *ASBS Newsletter* 185: 59-60 [2020] for the first) demonstrates that publishers believe there is still a market for large (and very expensive) hardback books on the world's most significant warm-temperate fruit-crop.

For many years, the Citrus 'Bible' was H.J. Webber and L.D. Batchelor's *The Citrus Industry* (1943-48, with a second [pruned] edition issued in the 1960s with later reprints; https://en.wikipedia.org/wiki/The_Citrus_Industry), a mighty five-volume book of which the most significant for systematists was Volume 1, 'History, botany, and breeding'. That included W.T. Swingle's taxonomic revisions, to varying depths, of the genus *Citrus* and its allies, making up Aurantioideae, now known to be the most natural subfamily of Rutaceae. Nothing quite like it has appeared since.

The current volume (written in American English), however, is a vast improvement on a book with exactly the same title by Giovanni Dugo and Angelo Di Giacomo (2002), as well as the other, very disappointing, offering of 2020 noted above. Although not covering the entire range of topics in Webber and Batchelor, especially in terms of the systematics of *Citrus* and its allies, this book bears a blurb proclaiming that it 'Increases understanding and inspires new research by providing the full scope from its evolution through recent genomic sequencing'.

The editors have succeeded in marshalling an international team of 86 authors – no mean feat in itself – contributing to 24 chapters, from 'The citrus genome' to 'Citrus and health', with each of the editors himself contributing to at least one. Nonetheless, there are, perhaps inevitably, discrepancies and inconsistencies between the chapters. However, each chapter is set out in an accessible, logical and understandable way, with consistent use of numbered subheadings; there are bibliographies (some with full references, some not) at the end of each, rather than a consolidated one at the end of the book, though there is a partial index there.

The first four chapters cover genomics, citrus origins, domestication and taxonomy; chapters 5 to 9 deal with commercial scions, rootstocks, traditional and genomic breeding, and biotechnology; 10 to 12 are devoted to vegetative growth, flowering and fruit-set, fruit growth and development; 13 to 15 cover citrus in changing environments, salinity and water deficit, soil and nutrition interactions; 16 to 19 deal with pests and diseases, 20 to 24 horticultural practices, post-harvest technology, citrus flavor [sic] chemistry, economics and marketing, closing with citrus and health. The sections most pertinent to readers of the *Newsletter* will likely be the opening ones, though there is an enormous amount of important information in the rest of the book, such that those chapters will reward scrutiny by even the most casually interested biologist.

Perhaps rather unfortunately, the book gets off to a shaky start with some rather unsurprising news in the first paragraph of Chapter 1: 'The genome is the fundamental basis of all living things. Plants of the genus *Citrus* are certainly no exception'. The chapter otherwise draws together recent genomics work, which on the whole confirms the conclusions of the pioneering (but here uncited) 1970s work by R.W. Scora who, using the biochemical taxonomic techniques of his time, was the first to argue that the principal cultivated citrus crops are largely of hybrid origin, involving four truly wild species, one of which was then yet to be identified. His work was the ultimate basis for a workable modern classification, elaborated in Australia in the 1990s, for commercial edible citrus. Although a classificatory system is found later in this new book, it is not employed consistently in this chapter or, indeed, throughout the volume, such that the names of genera long sunk on morphological grounds into *Citrus* (re-amalgamations supported by subsequent genomic work), are trotted out again and again. This makes for increased confusion for readers not steeped in citrology.

One important recent development is the confirmation (see the reviewer's *Plant-book* ed. 4: 207 [2017]) that most 'mandarins' in commerce are in fact backcrosses within the *Citrus* × *aurantium* ('*C. reticulata*' [wild mandarin] × *C. maxima* [pomelo]) orange-grapefruit complex, a problem being that the type specimen of *C. reticulata* is from the Philippines and thus likely such a backcross; the earliest name of the wild mandarin, one of Scora's four basic species, has therefore yet to be determined, but a contender is *C. tachibana* which is the name of what seems to be a truly wild tree native in Japan. The second and third parental species are the pomelo and the citron (*C. medica*) while the fourth, unidentified in Scora's time, has been confirmed to be makrut lime or limeleaves (*C. hystrix* [*C. micrantha* in this book], which was monographed some 20 years ago https://www.nparks.gov.sg/sbg/research/publications/gardens-bulletin-singapore/-/

media/sbg/gardens-bulletin/4-4-54-2-04-y2002-v54p2-gbs-pg-185.pdf).

The second chapter dealing with the origin of the *Citrus* group recognises three major clades in this genus of perhaps just 20 or so truly wild species, seven of which are native in Australia, likely the most *Citrus* species-rich country. These are a) the Pacific taxa (formerly *Clymenia*, *Eremocitrus*, *Microcitrus* and *Oxanthera*), with the citron and its ally *C. indica*, both from north-eastern India (though it is difficult to show that there are truly wild, rather than naturalized, citron populations left there today); b) the makrut-pomelo group; c) the mandarin – *C. ichangensis* (correctly *C. cavaleriei* – see https://openjournals.library.sydney.edu.au/index.php/TEL/article/view/8510) group, and all 'should be considered members of the genus *Citrus* although for clarity [sic] we will keep the traditional names of *Fortunella*, *Eremocitrus*, and *Microcitrus* in the chapter'.

Moreover, it is difficult to ascertain what is meant by 'wild' here and elsewhere in the book, as the term seems to be used to cover native species and introduced ones as well as naturalized hybrids, that have arisen when humans have moved individuals of the apparently originally allopatric species into the distribution areas of one another, leading to the mass of hybrid cultivars, very many of which are reproducing as apomictic clones. Such hybrids, often naturalized, growing in Australia include the lemon (*C.* × *limon* = *C.* × *aurantium* × *C. medica*), Mexican lime (*C.* × *aurantiifolia* = *C. medica* × *C. hystrix*), and rough lemon (likely C. × *jambhiri* ['C. × *limonia*' of this book - though that name cannot be used, as was shown some 25 years ago – https://www.biodiversitylibrary.org/page/57837341#page/77/mode/1up] = wild mandarin × citron).

Following Vavilov and earlier authors it is argued here that *Citrus* originated in the north-east India/ northern Myanmar/ south-west China nexus, with a secondary radiation into the Pacific, but the close relationship of the taxa there with the citron in India has been explained in other ways (see M. Heads, *Molecular panbiogeography of the Tropics*: 420–22, 2012).

The chapter on domestication again has some unfortunate, trite statements, notably (p. 33), 'Undoubtedly domestication is an ongoing process operating under the influence of human activities and nature [if human beings are not to be considered part of 'nature' – see pp. 1–11 in D.J. Mabberley, *Paradisus: Hawaiian plant watercolors by Geraldine King Tam*, 1999]'. We are told that our native '*Microcitrus*' 'is [sic] a delicate rainforest tree, when species in this group include xeromorphic ones like *C. gracilis* (the Humpty Doo lime from Kakadu), and that 'it' has long slender fruits, when most have round ones; again (p. 35), '*Clymenia* was indigenous in Australia' – perhaps Australasia was meant?

The chapter on taxonomy begins with the statement that *Citrus* 'is part of the Sapindales, order in the Rutaceae family'. Despite earlier chapters recognising that long-sunk genera are nested in *Citrus*, this chapter in at least part continues to recognise these redundant genera, though admitting that schemes used in today's standard floras are 'fully justified'. A new phylogenomic scheme proposed here hardly differs from that in use for the principal crops in those modern floras (Australia, China and upcoming North America, besides increasingly in European horticulture) but does set out the hybrid nature of other lesser citrus of local importance in, for example, Indonesia. Where it does differ is in proposing 'varieties', for what are groupings of cultivars, often apomictic lines within hybrid complexes (nothovarieties), yet such 'varieties' are horticultural groupings comprising cultivars that have arisen at different times and in different places, some selected from naturalized populations, some in plantations or raised in research stations. This is why a horticultural classification (using ICNCP) has been preferred in modern floras, as well as in hor-

ticultural literature in Europe and elsewhere. This is not the case merely for citrus, a prime example being another long-cultivated Asian crop, tea, where, long ago, I.H. Burkill (*Dict. Econ. Prod. Malay Penin.* 1: 419 [1935]) advocated the abandonment of 'the so-called varieties of botanists' when dealing with the variation in such cultivated clones.

In any case, at least some of the new varietal names here written as 'ined.' are likely to be nomenclaturally incorrect, as there are likely to be many published names at varietal level that will, according to ICN, take precedence over such, if formally proposed. It is unfortunate that someone skilled in nomenclatural and other taxonomic practice was not involved in compiling this schema. It is also unfortunate that even later chapters in the book do not use the system elaborated here.

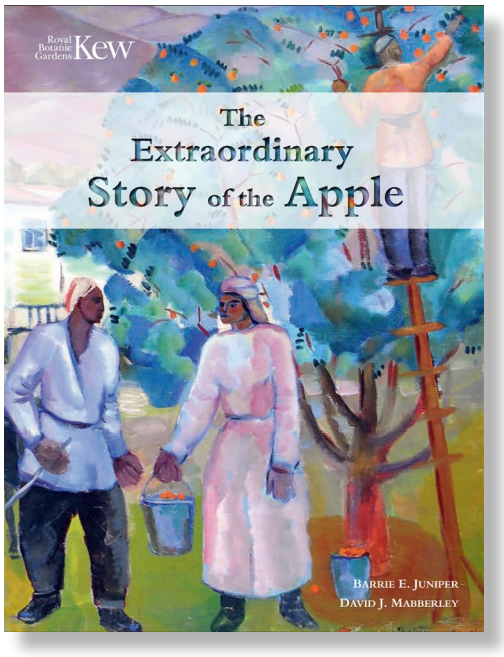
Recent authors are chided for providing no sectional or subgeneric structure for this small genus: with rampant hybridity across *Citrus*, such is perhaps inappropriate in any case. Moreover, it has to be pointed out that if, for example, infrageneric ranking were to be given to the three major clades, any subg. *Citrus* or sect. *Citrus* would, of course, include the type species, *C. medica*, so that the oranges for example would be in another grouping, perhaps subg. *Fortunella*. This is not needed.

Rather than such niceties, the chief concern of the citrus industry today, especially in the United States (though still not in the Mediterranean or, mercifully, Australia), is the presence of the incurable bacterial disease, huanglongbing (HLB, citrus greening). There are glimmers of hope in that there appears to be some resistance in Australian native citrus, but an explanation for the evolution of this is elusive. Sombrely, the chapter on citrus biotechnology concludes with the words, 'Due to a limited or non-existent seed supply for most new disease-resistant/tolerant rootstocks, micropropagation will be necessary to produce the millions of trees needed for replant efforts following HLB devastation. The challenges to maintaining a profitable and sustainable worldwide citrus industry have never been greater, and applications of the emerging biotechnologies will play a critical role for future success.'

This weighty volume is, in short, a well-illustrated source-book and major synthesis, but not flawless (nor with a reasonable price). More attention needs to be drawn to the status of the populations of the truly wild species including Australian and Papuasian ones – not merely for academic purposes or even conservation *per se*, but for food security. Furthermore, we still lack a new 'Swingle' with full descriptions and correct nomenclature of those wild species, with keys and full synonymy with typifications, then accounts of the interspecific hybrids (with correct nomenclature) and cultivar groups within them (such by their very nature likely to defy use of classical dichotomous keys). Any new edition of this book would therefore greatly benefit from opening with a synthesis of such a monographic account, providing the systematic and nomenclatural bases to be followed in the other chapters. Only then, will not only citrologists but also the whole horticultural trade, know what they are actually talking about.

Even more extraordinary

Book review by Caroline Grant



The Extraordinary Story of the Apple

Barrie E. Juniper & David J. Mabberley

ISBN 978 1 84246 655 1 (hardcover) 252 mm x 197 mm

Kew Publishing, Royal Botanic Gardens, Kew, 2019, pp 278

Retail price varies from around A$75 to A$90.

This is a new edition of the book published under the title *The Story of the Apple*, 2006. It has a beautiful image on the cover, a painting by Uzbek artist Ural Tansykbayev (1904–1974) called *Apple Picking*, done in 1933, which hangs in the Karalkalpakstan Museum of Art in Nukus, the capital of northern Uzbekistan. The colourful hardback edition is more eye-catching than the soft-cover Timber Press edition of 2006, and it contains beautiful colour photographs, some of which appeared in the earlier edition in lower resolution black and white.

Barrie Juniper and David Mabberley have had extensive careers in botany, and apparently Mabberley, who was taught by Juniper at Oxford, helped move Juniper's burgeoning apple tree collection in the 1960s. Extensive apple collections such as Brogdale in Kent and Geneva, New York, are noted, as well as the destruction of important collections during the 20th Century: for example, near Metz in France, the front line between the opposing forces in World War I. In World War II, the battle between the Red Army and the Wehrmacht was fought in the important apple-growing and nursery area of Kursk in European Russia. Later in the Soviet Union, anti-Mendelian repression caused two decades of persecution of geneticists including Nikolay Vavilov, who had set up many collections during the first half of the 20th Century.

Both editions cover the geographic origin of apples in the Tian Shan mountains in Central and inner Asia, how they migrated westwards along trade routes and became important in western culture, and how humans have learned to conserve certain apple characteristics by grafting, a skill which archaeological evidence at the site of the palace of Mari in Syria dates back 4,300 years. They do not cover the flavours and culinary use of apple varieties or cultivars: for that topic I recommend *The New Book of Apples: The Definitive Guide to Apples, Including over 2,000 Varieties* (London, Ebury Press, 2002) by Joan Morgan and Alison Richards, with beautiful paintings by Elisabeth Dowle, containing a directory of apple cultivars' characteristics and history.

At the time of the 2006 edition, the domestic apple's name was *Malus pumila* (Rosaceae, tribe Pyreae), and it was asserted that the genus *Malus* probably originated in the Tertiary period (65 to 2.6 million years ago) in southern China and spread through a continuous corridor of temperate forest as far as western Europe. In 2010 Velasco *et. al.* published 'The genome of the domesticated apple'. Their results showed that *M.* × *domestica* cultivars appeared closely related to

the wild species *Malus sieversii,* found in the fruit forest of the Tian Shan mountains.

In this 2019 edition, as commented upon by Mabberley in the appendix listing the wild species of *Malus,* the classification of apples is 'fraught with problems' due to different views of those who have worked on the genus and its allies. The accepted name is now *Malus domestica* (conserved over *M. pumila,* with *M. sieversii* a synonym) in the tribe Maleae, subtribe Malinae, with *Pyrus malus* as another synonym. Its type is apparently from a tree grown in Uppsala. There is evidence that the Maleae arose within the *Spiraea* group in North America and spread westwards to China, where species survived the glaciations until later recolonising North America.

The continuous forest corridor has been broken up, one relict being the fruit forest of the Tian Shan mountains which lie between Russia and China, and include parts of Central and inner Asia. These mountains have never been glaciated and contain many apple species. 'Tian Shan' means 'Heavenly Mountains' in Chinese. At 7,439 metres, the highest mountain is Jengish Chokusu, located on the Kyrgyzstan–China border. The mountains extend for 2,900 kilometres eastward from Tashkent in Uzbekistan, and lie to the north and west of the Taklamakan Desert, in the border region of Kazakhstan, Kyrgyzstan and Xinjiang in north-west China. In the south, the Tian Shan link up with the Pamir Mountains and in the east, the Altai Mountains of Mongolia.

Juniper and Mabberley argue that the unique combination of physical and biological characteristics found in that range was the driving force for the evolution of the domestic apple, so much larger and more palatable than many of the other apple species such as crab apples with which many people are familiar. They argue that, by comparison with the bird-dispersed fruits of other species, the fruit of the orchard apple is very large, suggesting that its original dispersal agents were large, herbivorous mammals and provide evidence of fruit being dispersed by bears, horses and other animals as well as humans on trade routes across Asia.

Being a landscape architect and having visited apple collections in England, one of the most interesting things for me was reading about the three phases of the apple crop which affect the appearance and qualities of the apples. There are literally thousands of apple cultivars in the world, with qualities varying from sweet to sour, some with rich flavours revealed when cooked over low heat for a long time (the same applies to some pear cultivars), some with red-blushed flesh, and others with less attractive skin such as 'Egremont Russet', which has its own enthusiastic supporters. Mabberley and Juniper group apples into three phases: early, mid and late season. These phases are based on an understanding of the fruit forest.

The characteristics of early season, or Phase 1 apples (July-August in the northern hemisphere), include being brightly coloured, often with a glistening skin, a fragrance, and frequently with a fine wax bloom which is found on the surfaces of many fruits at the point of perfect ripeness. Phase 1 apples are soft and thin-skinned, bruising easily, which makes them less than suitable for supermarkets. They are sweet and extremely juicy. As the book is British, the cultivars of the three phases mentioned are known in Britain, but many are available in Australia from specialist nurseries. Examples include 'Red Astrachan' (a Russian cultivar), 'Beauty of Bath', 'Discovery', 'Gladstone', 'Irish Peach', 'James Grieve', 'Lady Sudeley', 'Laxton's Early Crimson', 'Stark's Earliest' and 'Worcester Pearmain'.

Phase 2 apples: apparently as the season progresses, the apples are less brightly coloured, rarely if ever have a waxy bloom, and become harder skinned, less fragrant, but richer in flavour, with a firmer flesh, and can be stored for several months. Examples include the famous 'Cox's Orange Pippin',

'Allington Pippin', 'American Mother', 'Blenheim Orange', 'King of the Pippins', 'Laxton's Superb', 'Lord Lambourne', 'Orléans Reinette', 'Ribston Pippin', 'Sunset' and 'Winston'.

Phase 3 apples come at the end of the apple season. They are often very rich in flavour, lower in sugar, generally not fragrant, and with relatively dry pulp. Their skins are hard, dark, and frequently russeted (having harder patches of brown on the skin), and the fruit often fall off the tree without damage. They can hang on the tree for long periods and keep well, sometimes up to a year. Many are favoured as cooking apples. Examples in Britain include 'Ashmead's Kernel', 'Belle de Boskoop', 'Brownlee's Russet', 'Claygate Pearmain', 'Cornish Gilliflower', 'Ida Red', 'Norfolk Beefing', 'Sturmer Pippin' and, most famously in Australia, 'Granny Smith'.

Juniper and Mabberley argue that early fruits are selected to attract potential and perhaps naïve agents of dispersal, such as young bears which climb into branches. The attraction should operate over a short visual and olfactory range, hence the prevalence of bright, shiny colours, iridescent bloom, fragrance and juiciness. As the season progresses, and the animals become accustomed to this food source, other factors might assume importance. Apples that fall from the trees (without spoiling) extend the season of their availability. Their robustness and relative frost resistance will ensure that they are available to bears just prior to hibernation, when bears are mature enough not to climb trees. Apples will now be available to horses browsing on the edge of the forest and other animals such as boar and deer.

The Extraordinary Story of the Apple is a wonderful resource for learning about one of the most important and useful fruits in the world. A geological time scale and glossary of botanical terms would have been helpful. The appendix contains a classification and distribution of apple species, with a cautionary note: 'the genus in the Old World is in need of a modern taxonomic monograph', and the book contains a comprehensive list of references. I would like to acknowledge the help of Alex George when writing about the name changes to the domestic apple.

Obituaries

Helen Aston

26 March 1934 to 17 March 2020

Alex George with assistance from Jim Ross and Neville Walsh

This obituary draws on that by Gary Presland, *The Victorian Naturalist* 137: 90–91 (2020) and other sources.

Growing up on her parents' farm near Birrego, southern N.S.W., Helen's love of birds developed early. Moving to Melbourne, she completed her secondary schooling, then began training as a kindergarten teacher before working as a lab assistant at the Commonwealth Serum Laboratories. She then enrolled at The University of Melbourne, graduating with a double major in Botany and Zoology. She hoped to become a zoologist but was thwarted by the attitude of the day that precluded women from undertaking field work with men. Turning to her second interest, in 1957 she joined the National Herbarium of Victoria where she spent her working career, first as a lab assistant but soon becoming a botanist and rising to become Senior Botanist in 1965, then Curator in 1982. In 1987 she organised the storage of the whole collection in the Mueller Hall while the building was extended, devising a scheme that allowed access to all families, then supervised transfer to the new accommodation in 1988. She was editor of *Muelleria* from 1977 to 1988. After retirement in 1991, she continued as an Honorary Research Associate of the Herbarium.

Helen's taxonomic research came to focus on aquatic plants, in particular *Villarsia* and *Nymphoides*. Her major publication was *Aquatic Plants of Australia* (Melbourne University Press, 1973). It was the first comprehensive book on our water plants, illustrated with her own fine line drawings. She contributed the Podostemaceae, Pontederiaceae and Sparganiaceae to the *Flora of Australia*. Other contributions were to the *Flora of Central Australia*, *Flora of the Kimberley Region* and *Flora of Victoria* as well as *Freshwater Plants of Papua New Guinea*. She also published on *Triglochin* (Juncaginaceae). She named more than 20 species across her genera of interest and contributed about 3,000 specimens to MEL (e.g. see *ASBS Newsletter* 184: 59, 2020).

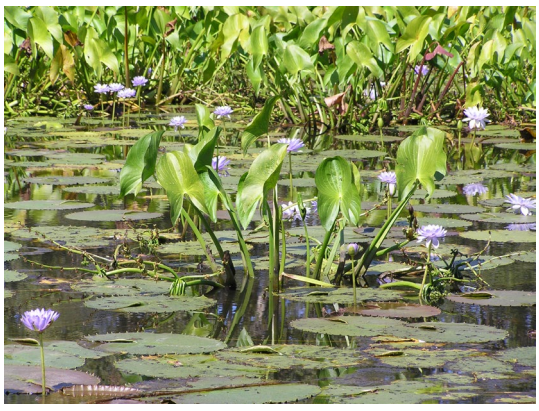
Helen was seconded as the 17th Australian Botanical Liaison Officer at the Royal Botanic Gardens, Kew, serving from 23 July 1973 to 6 September 1974. Besides inquiries from Australia, she fielded a number of requests from elsewhere, including two from the British Museum, one on food plants of mealy bugs and another on Aboriginal spears. In those early days of computerisation, she attended a seminar at Cambridge on automatic identification of biological specimens, and a session of a conference of the heads of European herbaria, organised by NATO, at which the feasibility of computerising herbarium records was debated.

In 1973 (before going to Kew), she attended the meeting at the National Herbarium of Victoria that established ASBS. She was Convenor of the Melbourne Chapter from 1976 to 1979.

Bird-watching remained her major hobby, however, and much time and many holidays were spent pursuing it, travelling widely around Australia and overseas. She joined the Royal Australasian Ornithologists' Union (RAOU), now Birdlife Australia, in 1951; the Bird Observers' Club in the following year (being President 1971–73); and the Victorian Ornithological Research Group (VORG) in 1963. She also joined several conservation organisations. She was co-author of the VORG's *Bird Atlas of the Melbourne Region* (1978) and a member of the Victorian sub-committee of *Atlas of Australian Birds* organised by the RAOU.

In 1979 Helen was awarded the Australian Natural History Medallion. She is commemorated in *Astonia* S.W.L.Jacobs and *Nymphoides astoniae* M.D.Barrett & R.L.Barrett.

Helen was very genuine and loyal to her friends, many of long-standing. Her leisure activities included walking, reading, music, and gardening. She loved camping and travel. Through all these was woven her bird-watching.



Astonia, with floating leaves of *Nymphaea*, Rinyirru National Park, Cape York Peninsula. Photo: John Clarkson.

Margaret Corrick

11 October 1922 to 12 August 2020

Alex George with assistance from Neville Walsh

This obituary draws on an article by Cathryn Coles on the occasion of Margaret's retirement from the National Herbarium of Victoria, *Botanic Magazine* 3: 41 (1988), and an obituary by Gary Presland, *The Victorian Naturalist* 137: 153–154 (2020).

Margaret Corrick (née Vaughan) was born in Hobart and gained an early love of the bush, joining the Tasmanian Field Naturalists' Club. She met Bill Corrick at the bank where she worked as a clerk, marrying in 1947. They were posted to various locations—Launceston, Leeton, then in 1962 to Casterton in Victoria, and in 1964 to Hamilton. They became active members of the local branch of the Field Naturalists' Club of Victoria

(FNCV), Margaret being secretary from 1965 to 1968. Fascinated by the flora of The Grampians, Little Desert and lower Glenelg area, she took up its study, assisted (in the absence of relevant books) by local botanist Cliff Beauglehole and the founder of the Australian Plants Society, Arthur Swaby.

On moving to Melbourne, Margaret continued to be active in the Field Naturalists' Club, especially the Botany Group, and became the Club's President from 1976 to 1978. She was Secretary to the General Committee of the Australian Natural History Medallion from 1973 to 1980, and was for many years the FNCV representative on that committee. A fellow member, Sheila Houghton, wrote that Margaret 'exemplified the purposes for which the Club had been founded, the self-taught amateur who became an expert in her field'. Margaret continued to assist with compilation of the club's newsletter until 2015.

As their children grew up, and having more time, in 1975 Margaret gained a part-time position as a Botanical Assistant, later Technical Officer, at the National Herbarium of Victoria (MEL), becoming full-time in 1976. She set herself high curatorial standards. An early task was to incorporate some thousands of specimens gathered by the former Assistant Government Botanist, Jim Willis. Following this was the even larger challenge of processing some 25,000 collections of Cliff Beauglehole, many of which Margaret determined or updated the taxonomy. The collections at MEL had been rather neglected in the years prior to Margaret's employment, with specimens stacked often precariously on already over-full cupboards. It was largely due to Margaret's perpetual practical approach that gradual order prevailed, allowing visiting botanists to find their target specimens. This approach extended to her views on taxonomy and life in general and she was often sought out as a sounding board for advice for younger botanists and staff in general.

Margaret became a knowledgeable taxonomist. She made over 10,000 plant collections, many in Western Australia during annual spring trips with Bill after the birth of their first grandchild in Perth in 1982. She took special interest in the genus *Pultenaea* and wrote 24 articles focused on the bushpeas of Victoria for *The Victorian Naturalist*, describing 6 new members of the genus. She contributed *Pultenaea* to the *Flora of Victoria* (1996) and, with photographer Bruce Fuhrer, co-authored two popular books: *Wildflowers of Southern Western Australia* (1996, 1997, 2009) and *Wildflowers of Victoria* (2000). Margaret also assisted Bruce in the preparation of *A Field Guide to Australian Fungi* (2005).

Margaret made many seed collections for the Royal Botanic Gardens International Seed Exchange. She was always willing to assist visiting botanists and to coach students who took vacation work at the Herbarium. She retired in 1985 and in 1995 was appointed an Honorary Associate at the Herbarium, continuing to contribute specimens to the Herbarium until 2007. She joined the Australian Systematic Botany Society in 1983 and regularly attended meetings of the Melbourne Chapter.

Margaret is commemorated in *Hovea corrickiae* J.H.Ross and *Tietkensia corrickiae* P.S.Short.

News

Online and in the media

Todd McLay

Saving the sweet potato's name

The sweet potato (*Ipomoea batatas*) is the seventh most important crop in the world (annual production c. 90 million tonnes). Molecular evidence has found that *Ipomoea* is polyphyletic, and sweet potato is in a different clade from the type (*Ipomoea pes-tigridis*). The Convolvulaceae Network, a group of people who work on the family, meets on Fridays to discuss issues such as these. In a recent paper in *Taxon*, the network put forward an argument that *Ipomoea batatas* should be maintained, on the basis that changing the name would be costly and potentially cause communication breakdowns throughout industry and government. This, of course, would involve designating another species as the type for the genus; not insignificant for a genus with over 600 species found throughout the tropics and subtropics.

https://docs.google.com/forms/d/e/1FAIpQLSeZQwJmk-pjWinVLdJWLI_ZbsIL-4Cwzfmn5zNwHlhG1Rw39Yg/viewform

https://nationalpost.com/life/food/scientists-unite-to-save-the-sweet-potatos-identity?fbclid=IwAR3VX5y-kbygXI-WFolUc-Z2keKm5IZoBxey3NwQ03Q7ip-pC8U7iT9Ad_Sl8

Interviews with the author of *Herbarium: The Quest to Classify and Preserve the World's Plants*, Barbara Thiers

During herbarium tours, guests would ask Dr Barbara Thiers (New York Botanic Gardens) if there were any books about herbaria, and Dr Thiers would have nothing to suggest. To rectify this, she took matters into her own hands. *Herbarium* includes the historical uses of herbaria, how the people and plants are linked across the world, present uses that could not have been imagined by early herbarium staff, and future uses that are only beginning to be realised now.

https://www.nybg.org/planttalk/telling-the-story-of-the-quest-to-preserve-and-classify-the-worlds-plants/

Also reviewed in *The Financial Times*, The 'big data' of botany" (subscription required)

https://www.ft.com/content/61206e84-fb68-412d-91f5-920299bf5d5e

[Editorial note: there are three (maybe more) books on herbaria:

Bridson, D. & Forman, L. (eds) (1993), *The Herbarium Handbook*, Royal Botanic Gardens, Kew.

Stacey, R. & Hay, A. (2004), *Herbarium*, Cambridge University Press, Cambridge.

Morat, P., Aymonin, G. & Jolinon, J.-C. (2004), *L'Herbier du monde: Cinq siècles d'aventures et de passions botaniques au Muséum national d'histoire naturelle*, Les arènes/L'iconoclaste, Paris.]

Stories from the field: collecting in the Kimberleys

Mike Lyons of the WA Herbarium talks about his time collecting in the Kimberleys over the last 10 years. His story provides some insights into one of Australia's most remote areas, including the approximately 4,300 specimens collected, his unquenchable thirst, encounters with snakes and crocs, and some nice herbarium advocacy at the end.

https://www.abc.net.au/news/2020-12-06/helicopters-remote-islands-and-firearms-herbarium-collection/12934426?fbclid=IwAR0Q5iuGIzNnD6gma3pDHJWWug1xyw-ZeiUA9UzxqCewtzX_-F4A5b5XghmU

Retired teacher becomes working taxonomist

At 58, Pam Catcheside left teaching and retrained as a mycologist. Her contributions to fungal taxonomy include nearly 5,000 collections, identification of ~20 new species, describing three new species and one new genus (with her husband performing the molecular work), and working on Fungimap. Her specialist group is the cup and disc fungi (Ascomycota), which are important as mycorrhiza associations or in nutrient cycling.

https://www.theguardian.com/lifeandstyle/2021/jan/06/never-too-late-how-a-retired-teachers-fungi-hobby-led-to-her-finding-20-new-species?CMP=Share_iOSApp_Other&fbclid=IwAR1nzy3eewIs-qZdA75itoG26P1gbIYvx6d-JeEeMQk6nC-qY2olCltJajIME

Entoloma ravinense. Photo courtesy of fungimap.org.au. by D. Catcheside.

Taxonomy based on illegally collected specimens

In 2018, an amateur insect taxonomist named a new centipede from the Philippines in *Zootaxa*. *Scolopendra paradoxa* is a strikingly coloured animal, and the publication garnered a lot of attention. The problem is, according to the Philippines Government, the specimen was collected illegally as the author did not carry an appropriate permit. The author claims that he didn't know it was illegal, and the fact that it was not collected with a permit was not caught in peer review by any of the five (!) reviewers or the editor.

https://www.sciencemag.org/news/2021/02/illicit-centipede-raises-thorny-question-should-journals-have-refused-publish-paper

The centipede: *Scolopendra paradoxa*. Photo courtesy of sciencemag.org

Are plants sentient?

Or rather, do plants possess intent? Researchers used time-lapse photography to document the behaviour of 20 potted bean plants; using this footage, they analysed the dynamics of the shoots' growth. They found the plants' approach was more predictable when a supporting pole was present, showing goal-directed behaviour. This is apparently analogous to sending a blindfolded person into a room containing an obstacle, and either telling them about it or letting them stumble into it.

https://www.theguardian.com/environment/2021/jan/08/food-for-thought-french-bean-plants-show-signs-of-intent-say-scientists?CMP=soc_567&fbclid=IwAR2bOdbgDs6SqXpnVFqQGmexWTGJVyjhtiGTN4qJraFczi1IKFeYXLbjnFI

Papers and publications

Botanical monography in the Anthropocene

A review on monographs, including what they are, impacts of monographs, recent innovations, and criteria for prioritising future monographic efforts. A useful paper to have on hand.

Botanical Monography in the Anthropocene, Grace *et al.*, 2021, *Trends in Plant Science*

https://www.sciencedirect.com/science/article/pii/S1360138520303952

Using herbarium specimens for conservation action

Herbaria provide important baseline information for plant conservation, including occurrence records, species ranges, and population size (and change over time). In this review the authors examine ways that the physical herbarium specimen can be extended for conservation. Topics include measuring present and past genetic diversity, using propagules on specimens as a source of genetic material for restoring or reintroducing species through translocation, raising awareness, and the emerging utility of machine-learning for extracting information.

Reversing extinction trends: new uses of (old) herbarium specimens to accelerate conservation action on threatened species, Rocchetti *et al.*, 2021, *New Phytologist*

https://nph.onlinelibrary.wiley.com/doi/10.1111/nph.17133

Valuable contributions of small herbaria

In this interesting research, the authors set out to identify and quantify the value of smaller herbaria for botanical research. To do so, they compared specimen data for 40 species held in small (<100,000 specimens) and large (>100,000) herbaria. They found that small herbaria hold unique specimens and contribute important information for research, especially for local taxa, and they help to fill gaps to ameliorate sampling bias. Additionally, many small herbaria in the US are associated with universities, where repeated collection by students can provide temporal datapoints.

Small herbaria contribute unique biogeographic records to county, locality, and temporal scales, Marsico *et al.*, 2020, *American Journal of Botany*

https://bsapubs.onlinelibrary.wiley.com/doi/10.1002/ajb2.1563

The origin of Darwin's 'abominable mystery'

There is little doubt that Darwin's abominable mystery remains one of the greatest questions in plant evolutionary science. The rapid rise to dominance of angiosperms during the Cretaceous confounded Darwin, and to this day the age of the origin of flowering plants is contentious (see Coiro *et al.*, 2019 'How deep is the conflict between molecular and fossil evidence on the age of angiosperms?').

In this article, the author reviews the classification system and known fossil record of Darwin's day that likely guided Darwin to his original comments.

The origin of Darwin's "abominable mystery", Buggs, 2021, *American Journal of Botany*

https://bsapubs.onlinelibrary.wiley.com/doi/10.1002/ajb2.1592

Fossil data support pre-Cretaceous flowering plants

In a new approach to investigating the origin of angiosperms, these authors developed a method of estimating ages of angiosperm families using a fossil dataset comprising 15,000 occurrences in 198 families. Rather than using phylogenetic dating, which typically places the emergence age further back

in time than the oldest fossils, the method attempts to estimate the age of families using known, present-day diversity as well as the fossil record. Their results suggest that several families originated in the Jurassic (Lardizabalaceae, Papaveraceae, Triuridaceae), and up to 20% of families had origin dates with credible intervals in the Jurassic. They also identified an increased rate of lineage accumulation 125 to 72 Ma, in line with Darwin's hypothesis.

Fossil data support a pre-Cretaceous origin of flowering plants, Silvestro *et al.*, 2021, *Nature Ecology & Evolution*

https://www.nature.com/articles/s41559-020-01387-8

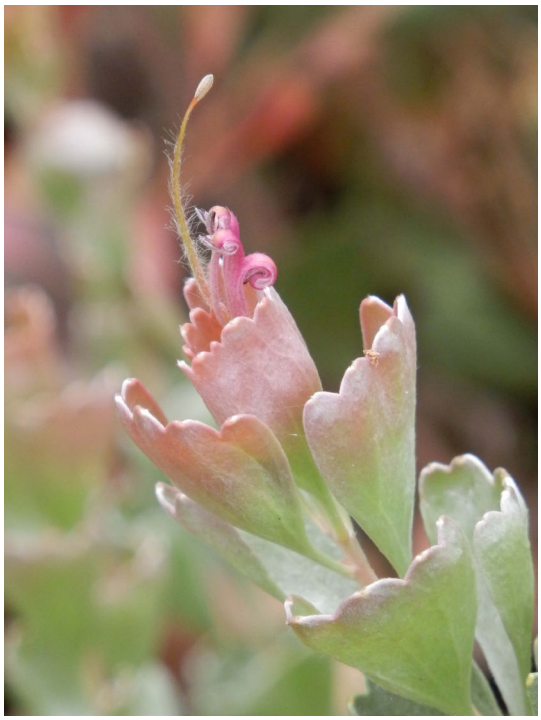
For further reading, Budd *et al.* disagree with the major findings of this paper and have published their comments on bioRxiv (not peer reviewed at this stage):

https://www.biorxiv.org/content/10.1101/2021.02.16.431478v1

The complex evolutionary history of *Adenanthos*

With the ability to assemble large, multi-locus nuclear datasets, we are now able to gain greater insights to the complex evolutionary histories of genera that were previously obscured using a handful of chloroplast or nuclear ribosomal markers. Nge *et al.* provide a great example of this in *Adenanthos* (Proteaceae). In terms of reticulate evolutionary process, the authors identified cases of both recent and ancient hybridisation, incomplete lineage sorting through retention of ancestral chloroplast sequences, and a rapid radiation associated during the Miocene.

https://www.frontiersin.org/articles/10.3389/fevo.2020.616741/full



Adenanthos cuneatus. Photo: Alex George

Adenanthos obovatus. Photo: Alex George

Golden anniversary just two years away

The Australian (now Australasian) Systematic Botany Society was formed at a meeting in Melbourne in April 1973 and the first General Meeting held in August that year in Perth, Western Australia. This means that the Society is just two years away from celebrating its 50th anniversary. Hopefully the coronavirus pandemic will have been consigned to history by then and we can meet face-to-face. In the meantime, as a way of building towards 2023, beginning later this year, Council plans to run a regular feature in the *Newsletter* delving into the past 50 years and looking forward to its next half century.

Council would welcome hearing from members, young and old, who might have ideas of how we could build towards this significant milestone. Contact Mike Bayly or John Clarkson.

The original logo that appeared on the cover of the first five issues of the *Newsletter* until it was replaced with the image of a *Xanthorrhoea* in November 1975.

Subscriptions for ASBS membership due

John Clarkson ASBS Treasurer

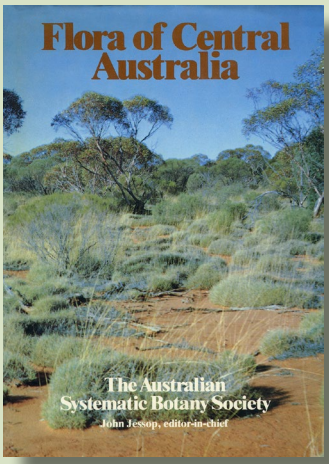
Subscriptions for ASBS membership were due on January 1. Subscription rates for 2021 remain unchanged at:

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

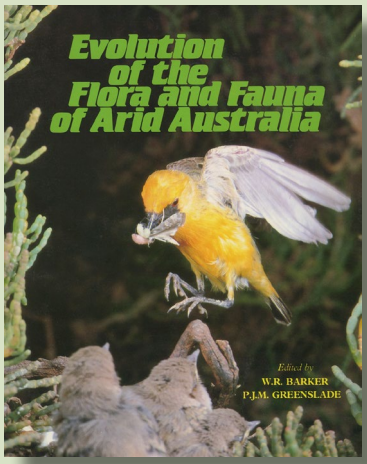
Renewal forms are available on the ASBS web page at: http://www.asbs.org.au/asbs/membership.html

If you have not received an email from me reminding you of this it probably means that I have an out of date email address. Please get in touch with me.

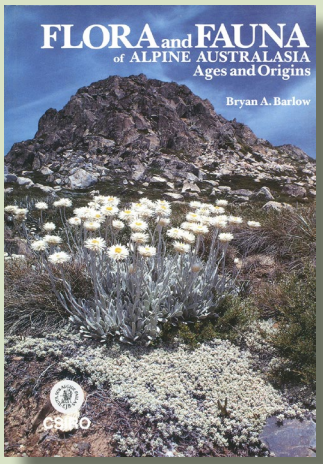
Flashback: past ASBS publications



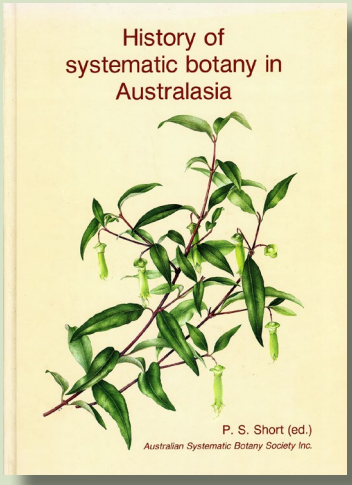
Flora of Central Australia (1981)



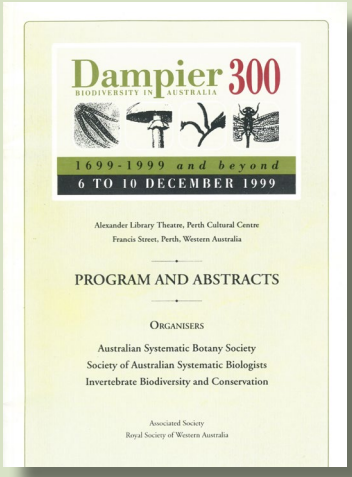
Evolution of the Flora and Fauna of Arid Australia (1982)



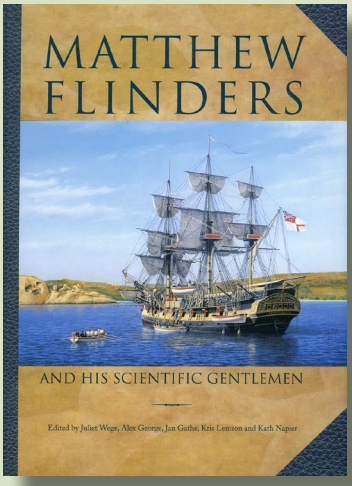
Flora and Fauna of Alpine Australasia (1986)



History of Systematic Botany in Australasia (1990)



Dampier 300 (1999)



Matthew Flinders and His Scientific Gentlemen (2005)

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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Advertising Advertising space is available for products or services of interest to ASBS members at the following rates (AUD):

Full page: $200
Half page: $100
Flyers: $250

A 20% discount applies for regular advertisements. ASBS members are exempt from advertisement fees but not insertion costs for flyers ($50). For advertising enquiries please contact the editor.

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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.

Chapter conveners

Adelaide
Robyn Barker
State Herbarium of SA
(+618)/(08) 8222 9348
robyn.barker@sa.gov.au

Armidale
Jeremy Bruhl
University of New England
(+612)/(02) 6773 2429
jbruhl@une.edu.au

Brisbane
Vacant

Cairns
Katharina Nargar
ATH, JCU
(+617)/(07) 4232 1686
katharina.nargar@csiro.au

Canberra
Alexander Schmidt-Lebuhn
CSIRO
(+612)/(02) 6246 5498
Alexander.S-L@csiro.au

Christchurch
Rob Smissen
Allan Herbarium
(+643)/(03) 321 9803
smissenr@landcareresearch.co.nz

Darwin
Ian Cowie
Northern Territory Herbarium
(+618)/(08) 8999 4511
ian.cowie@nt.gov.au

Hobart
Miguel de Salas
Tasmanian Herbarium
(+613)/(03) 6226 1806
Miguel.deSalas@tmag.tas.gov.au

Melbourne
Frank Udovicic
National Herbarium of Victoria
(+613)/(03) 9252 2313
frank.udovicic@rbg.vic.gov.au

Perth
Juliet Wege
Western Australian Herbarium
(+618)/(08) 9219 9145
Juliet.Wege@dbca.wa.gov.au

Sydney
Peter Weston
National Herbarium of NSW
(+612)/(02) 9231 8111
peter.weston@rbgsyd.nsw.gov.au

Wellington
Heidi Meudt
Museum of New Zealand Te Papa Tongarewa
(+644)/(04) 381 7127
HeidiM@tepapa.govt.nz

Major Australasian herbaria and systematics institutions contacts

AD
(+618)/(08) 8222 9307
stateherbsa@sa.gov.au

HO
(+613)/(03) 6226 2635
herbarium@tmag.tas.gov.au

MEL
(+613)/(03) 9252 2300
pina.milne@rbg.vic.gov.au

NSW
(+612)/(02) 9231 8111
herbarium.nsw@rbgsyd.nsw.gov.au

CANB
(+612)/(02) 6246 5084
cpbr-info@anbg.gov.au

BRI
(+617)/(07) 3896 9321
queensland.herbarium@qld.gov.au

CNS
(+617)/(07) 4232 1837
enquiry@ath.org.au

PERTH
(+618)/(08) 9219 8000
herbarium@dbca.wa.gov.au

NT
(+618)/(08) 8951 8791
herbarium@nt.gov.au

DNA
(+618)/(08) 8999 4516
herbarium@nt.gov.au

AK
(+649)/(09) 306 7060
info@aucklandmuseum.com

CHR
(+643)/(03) 321 9999
schonbergeri@landcareresearch.co.nz

WELT
(+644)/(04) 381 7261
Antony.Kusabs@tepapa.govt.nz

Australian Biological Resources Study (ABRS)
(+612)/(02) 6250 9417
abrs@environment.gov.au

Council of Heads of Australasian Herbaria (CHAH)
Chair: John Huisman
Western Australian Herbarium
john.huisman@dbca.wa.gov.au
Australian University Herbaria
Rep.: Frank Hemmings
University of New South Wales
f.hemmings@unsw.edu.au

Taxonomy Australia
taxonomyaustralia@science.org.au

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