fostering research into the biology and cultivation of the Australian flora

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Welcome to our new Councillor

Michelle Leishman was elected to the Foundation's Council at the AGM in December 2011.

Michelle is an Associate Professor in the Department of Biological Sciences, Macquarie University.

She is a plant ecologist with a special interest in Australian vegetation and plant adaptations to the environment. Michelle completed her PhD in 1993 at the School of Biological Sciences, Macquarie University. Her thesis is titled *Comparative seed and seedling biology of the semi-arid woodland flora of western New South Wales*.

Her main areas of research are on the ecological strategies of plants. Her current research focuses on understanding the success of invasive plants and developing sustainable vegetation restoration methods, and includes:

- Responses of invasive plants to global climate change and elevated carbon dioxide
- Interactions between invasive plants and the soil microbial community
- Ecology of African Olive
- Relating plant volatile organic compound emissions to functional traits
- Development of guidelines for the restoration of woodland and riverside vegetation

Amongst other distinctions she has been the recipient of an ARC Queen Elizabeth II Research Fellowship (2000-2006), and is an Associate Editor of the Journal of Ecology. She is currently Deputy Chair of the NSW Scientific Committee.

Current research in fire ecology

Dr Tina Bell*

Regular, recurrent fires have been part of the Australian environment since at least the early Quaternary (2.6 million years ago) and possibly since the late Cainozoic (5 million years ago). Sclerophyllous vegetation in temperate regions of Australia has evolved against a background of frequent fires, low nutrient soils and seasonal summer drought. As a result, contemporary floras have developed to a point where they require fire for regeneration and renewal. The substantial body of research related to fire ecology in Australian ecosystems was collated in 2002 in 'Flammable Australia: the fire regimes and biodiversity of a continent' and reviewed again in 2012 in 'Flammable Australia: fire regimes, biodiversity and ecosystems in a changing world'. The knowledge that we have gained in the intervening decade is highlighted in this article.

Predictions for changes in fire regimes (frequency, season, intensity and extent of fires) have received considerable attention over the last 10 years in accordance with increasing awareness of global climate change. Fire frequency has been forecast to increase, and as this component of a fire regime is important for determining community composition and the size of plant and animal populations, many species may be affected adversely. While predicted changes in fire intensity and fire extent will impact on populations, and shifts in burning season may affect individual species (e.g. burning in spring and autumn rather than summer alone), the effects are not likely to be as great as those caused by increased fire frequency.

Advances in fire behaviour modelling have been considerable over the last decade because of improvement in model components related to fuel type and distribution, interactions of fire with the atmosphere and, importantly, more detailed and accurate inputs into these models. More is now known about how fast fires can spread in different vegetation types, how spot fires are spread in front of the fire and what conditions are required for them to propagate. Within the last 10 years, fire behaviour models have been developed or refined for a range of vegetation types including heathlands, mallee-heath, Spinifex grasslands, dry eucalypt forests and pine plantations. Long- and short-term weather forecasting has improved dramatically in recent years and there is increasing knowledge about how particular features of the Australian climate interact to determine 'fire weather', including what happens during catastrophic fire events. There has also been enhanced mapping of landscape topography, vegetation type and fire extent using satellite remote sensing.

Although it is useful to know the fire ecology of individual species, it is difficult to imagine a time when we have that information at our finger tips for every plant and animal in Australia. Instead it is far more practical to develop a set of indicators or generalisations that can describe plant and animal responses to fire and how this may affect populations and communities. For example, understanding the life cycle of geophytic plants (or plants that grow during the wet season and die back to an underground storage organ in summer) as opposed to gathering information for each and every orchid in an area is more realistic and achievable for predicting the effect of spring or autumn burns. In relation to how plants respond after fire, functional and life-history approaches have been explored since the early 1980s. Such models have provided a valuable

framework for land management agencies for developing and monitoring fire management strategies. Recent research has refined these models to become more process-based than outcome-based and relevant to communities and landscapes rather than individuals and populations. Regardless of development stage, models involving plant life-history strategies are relatively well advanced compared to those for animals. Models for predicting and managing fire response of fauna will need to take into account responses to changes in resources such as food and shelter and processes such as dispersal, competition and predation.

Working with soil and soil biota is notoriously difficult and is often the least well studied component of natural ecosystems. Many organisms spend part or all of their life belowground and take advantage of the small-scale variation that is common, and indeed characteristic of soil. Along with plant roots, bacteria, fungi, algae, and a multitude of invertebrates live in soil and are collectively responsible for cycling of carbon and nutrients such as nitrogen and phosphorus. Within the last 10 years, the incredible diversity of soil flora and fauna has been revealed with advances in molecular and biochemical techniques. As an indication, it has been estimated that there are 1.5 million species of fungi, many of which are likely to be found in soil. Interactions among functional groups of soil flora and fauna have recently been investigated and food webs that are more complex than their aboveground terrestrial counterparts have been established. Fire impacts on trophic and competitive interactions directly through death of soil biota in the uppermost layer of soil and through alteration of aboveground inputs of carbon and energy. Fire will impact on soil biota indirectly through physical and chemical changes occurring as aboveground biomass recovers after fire.

The study of fire ecology in Australia will continue to measure the response of biota to be able to understand and predict the fundamental nature of fire regimes. However, such study should also consider the effects of global climate change and escalating social, economic and political pressures. One of the biggest tasks ahead of us will be to incorporate new knowledge into fire management schemes. The challenge of securing research funding and a creating and maintaining a talented and engaged cohort of students and new scientists will always remain.

Further reading:

Bradstock RA, Williams JE, Gill AM, eds. (2002) Flammable Australia: the fire regimes and biodiversity of a continent. Cambridge University Press.

Bradstock RA, Gill MA, Williams RJ (2012) Flammable Australia: fire regimes, biodiversity and ecosystems in a changing world. CSIRO Publishing.

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*Tina Bell is a Councillor of the Australian Flora Foundation. She is Senior Lecturer in Fire Ecology at the University of Sydney, and is currently a Project Leader in the Bushfire CRC and has been a member of this national research centre since its inception in 2002.

Summaries of Final Reports

Each year the Australian Flora Foundation funds a number of grants for research into the biology and cultivation of the Australian flora. While the grants are not usually large, they are often vital in enabling such projects to be undertaken. Many of the projects are conducted by honours or postgraduate students, hopefully stimulating their interest in studying Australia's unique and diverse

plants. This work is only made possible by the generous support of donors and benefactors.

Presented here are brief summaries of completed projects. Full reports of these and other projects can be viewed on the Foundation's website www.aff.org.au

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An evaluation of the temperature and daylength requirements of Australian potted colour species

Dr Margaret Johnston, Land Crop and Food Sciences, The University of Queensland, Gatton, Queensland

Calandrinia sp. (Mt Clere)

Brunonia australis

Australian research on flowering physiology has reported a range of diverse flowering responses to temperature, daylength and light intensity. Development of new potted colour plants requires investigation of the effect of environmental factors on flowering to enable manipulation of flowering time. In addition it is important to understand juvenility and determine when the seedling is able to perceive the flowering signal as well as quantifying the effect of environmental factors on flower induction, initiation and development. Environmental factors also influence plant habit particularly height and branching and this can influence the number of flowers per plant and hence plant quality. Plant growth regulators can be used to modify plant habit and may also influence flowering.

Two studies were undertaken in this project. The first study, on *Brunonia australis* and *Calandrinia* sp., investigated the use of daylength and growth regulators, gibberellic acid (GA3) and paclobutrazol (Pac), to control vegetative growth, peduncle elongation and flowering of *Brunonia* and *Calandrinia*. Plants were grown under long days (LDs;16h), short days (SDs; 11h) and SDLDs (8 weeks SDs followed by LDs). Plants in each daylength were treated with GA3, Pac, and GA3+ Pac. GA3 was applied as a 10 µL drop of 500 mg L-1 concentration to the newest mature leaf. A single application of Pac was applied as a soil drench at 0.25 mg a.i. per plant.

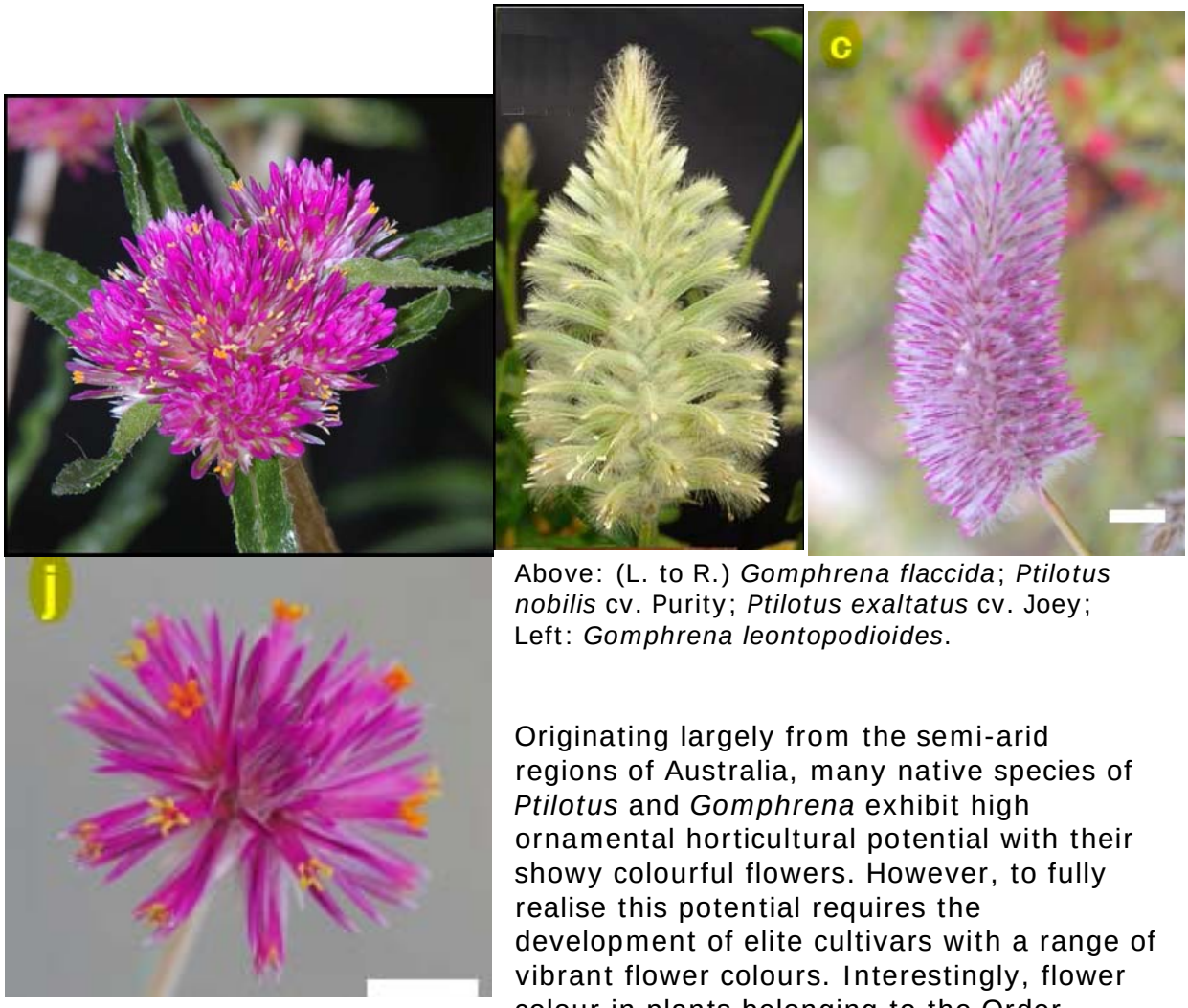
Both *Brunonia* and *Calandrinia* were classified as facultative LD plants. *Brunonia* plants grown under SDLDs were more vigorous and attractive. In *Brunonia*, GA3 promoted earlier flowering and increased the number of inflorescences under SDs while Pac applied alone or in combination with GA3 delayed flower development in *Brunonia*. Vegetative growth of *Calandrinia* was similar under

LDs, SDs and SDLDs. Pac-treated *Calandrinia* were compact and attractive, and Pac application did not affect time to flower and flower number, while plants treated with GA3 were unattractive.

The second study investigated the flowering response of *Pycnosorus thompsonianus* to daylength and temperature regime. Plants were grown at 20/10°C or kept at 30/20°C for 21 or 42 days under SDs, LDs, or SDLDs (6 weeks SDs followed by LDs). LDs promoted earlier flowering and plants under LDs flowered regardless of temperature regimes. Cool temperatures were required for flowering of plants under SDs. Plants under SDs without cooling only produced 3 inflorescences per plant whereas plants which received 21 or 42 days of cooling had 19. Forty-two percent of the SD plants under 30/20°C remained vegetative after a 20 week growing period. Extending the cooling period from 21 to 42 days induced earlier flowering of plants in all daylengths but did not increase number of inflorescences per plant. Daylength was more effective than temperatures for promoting earlier flowering and for increasing flower production.

Understanding the biochemical basis of flower colour in Australian native *Ptilotus* and *Gomphrena*

Dr Dion Harrison, Dr Jitka Kochanek, Professor Daryl Joyce, Centre for Native Floriculture, School of Land Crop and Food Sciences, The University of Queensland, Gatton, Queensland



Above: (L. to R.) *Gomphrena flaccida*; *Ptilotus nobilis* cv. Purity; *Ptilotus exaltatus* cv. Joey; Left: *Gomphrena leontopodioides*.

Originating largely from the semi-arid regions of Australia, many native species of *Ptilotus* and *Gomphrena* exhibit high ornamental horticultural potential with their showy colourful flowers. However, to fully realise this potential requires the development of elite cultivars with a range of vibrant flower colours. Interestingly, flower colour in plants belonging to the Order Caryophyllales, such as *Ptilotus* and *Gomphrena*, results from the rarely studied

betalain pigments rather than the more common and well-researched anthocyanin pigments that are found in most flowering plants.

This project investigated the biochemical basis of flower colour for seven Australian *Ptilotus* and three Australian *Gomphrena* accessions. In total, ten major and three minor betalain pigments were identified, including five unknown betalain pigments. This knowledge provides the first steps needed to facilitate the development of new Australian *Ptilotus* and *Gomphrena* cultivars with novel flower colours for ornamental horticulture.

Given that betalain research is still in its relative infancy, this project also makes an important contribution to our understanding of betalain pigments in previously unstudied Australian native plant species.

Young Scientist awards for 2011

For some years the Foundation has awarded prizes to under or post graduate students who make presentations at the Ecological Society of Australia's Annual Conferences. It does this to encourage young scientists to study Australian plants and to make them aware of the Foundation's activities.

We congratulate the two winners of the Australian Flora Foundation Young Scientist Prizes awarded at the Annual Conference of the Ecological Society of Australia held in Hobart in November 2011, who were:

Spoken Presentation - Sarah Butler, School of Geography, Planning and Environmental Management, University of Queensland: *Agricultural land use history increases invasions in regenerating fragmented ecosystems, compromising understorey flora diversity*.

Poster Presentation - Amity Williams, Terrestrial Ecology Research Group, Murdoch University: *Climate change impacts on the northern sandplain Kwongan vegetation of SW Australia.*

The AFF Council – what does it do, exactly?

The names of the members of our Council and office bearers appear on the last page of this Newsletter. Readers might like to know a little more about the Council and its function.

All Councillors are keenly interested in and have a strong concern for our native plants and natural ecosystems, and as you would expect are strongly committed to the Foundation's objective – to foster research into the biology and cultivation of the Australian flora. They bring a range of relevant skills and experience to meetings, comprising leading academics who themselves have been involved in research in this field, plus long-time members of the Australian Plants Society.

A major responsibility of Council in pursuing its objective is to choose the projects to be funded. This is initiated each year by circulating invitations for preliminary applications to researchers at University Research Offices, Botanic Gardens, State Departments of Agriculture/Environment/Natural Resources, and CSIRO offices around Australia. These preliminary applications are considered at the April Council meeting, where the most appropriate are selected and the

applicants asked for full applications. This year 30 preliminary applications were received.

The full applications are then reviewed by the Scientific Committee. The Scientific Committee comprises senior scientists with wide experience and expertise in researching Australian flora. The members of the Scientific Committee are set out on the last page of this Newsletter. The full applications together with appraisals thereon by the Scientific Committee are considered at the August Council meeting, and the choice is then made of the ones to which funding will be committed. Last year $55,360 was approved for funding of research projects.

Another responsibility of Council is to ensure that research funds are available for distribution each year, and will be available in future years. We follow a conservative approach with our investments and with the annual allocation of income to research. We continue to encourage donations and bequests in our publicity material.

Council meets three times a year. In between meetings any issues that arise are dealt with by the office bearers or by email. Regular agenda items include Treasurer's report, investment strategy, applications for grants, final research reports, publicity, website activity, and student awards. There is a Finance Sub-committee of Council that makes recommendations to each meeting on investments and other financial matters.

Under our constitution the Council consists of the office bearers (a president, two vice-presidents, a secretary and a treasurer) plus eight ordinary members, making a total of thirteen Councillors. Currently we have ten Councillors. Note: if you would like to apply for one of the vacant positions please let us know!

Councillors are elected by members at Annual General Meetings. At each AGM one-third of Councillors must retire, being those longest in office, and are eligible for re-election. The Council may appoint a person to fill a casual vacancy, and if so that person holds office only until the next AGM, when they are eligible for re-election.

The Council appoints one of its members as a Public Officer, who is responsible for reporting to and liaising with government authorities. It also appoints a suitably qualified external auditor.

Thank you to our donors

Without the generous support of our donors and benefactors the Foundation would not be able to carry out its research objectives. The Foundation is recognized by the Australian Taxation Office as a Deductible Gift Recipient, and donations of $2 and over are tax-deductible.

The Council sincerely thanks the following supporters who have recently made donations to the Research Fund:

Australian Plants Society Newcastle Group NSW; Australian Plants Society NSW Region; SGAP Mackay Branch Queensland; Ms B. Buchanan; Dr Roger Carolin; Mr Ian Cox; Dr Rhonda Daniels; Mrs Hazel Dempster; Mr Phillip Esdale; Mr Frank Gleason; Dr Peter Goodwin; Mrs E. King; Mrs Margaret Lee; Dr Paddy Lightfoot;

Dr M. L. Reed; Mr W. Reed; Mr Ross Smyth-Kirk; Mrs Diana Snape; Dr Robert Vickery; Dr A. Wheeler; Professor Richard Williams;

The Australian Flora Foundation is a not for profit organization with the sole objective of fostering scientific research into Australia's flora. We are totally independent, and all office bearers are volunteers.

The Council (*governing body*):

- Dr Peter Goodwin (President)
- Professor Richard Williams (Vice President)
- Associate Professor E. Charles Morris (Vice President)
- Mr Ian Cox (Secretary)
- Dr Jenny Jobling (Treasurer)
- Dr Tina Bell
- Associate Professor Michelle Leishman
- Dr Paddy Lightfoot
- Dr David Murray
- Mr Ross Smyth-Kirk

The Scientific Committee:

- Professor Richard Williams (University of Queensland) - Chair
- Professor Kingsley Dixon (Kings Park & Botanic Gardens, WA)
- Associate Professor Betsy Jackes (James Cook University)
- Associate Professor Peter McGee (University of Sydney)
- Dr Trevor Whiffin (LaTrobe University)

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