AUSTRALIAN FLORA FOUNDATION

fostering research into the biology and cultivation of the Australian flora

Newsletter *No. 14* *New Series*

July 2011

AFF welcomes new Councillor

Dr Tina Bell is a Senior Lecturer in Fire Ecology in the Faculty of Agriculture, Food and Natural Resources at the University of Sydney. She obtained her BSc and PhD from the Department of Botany at the University of Western Australia. She has researched the ecophysiology of native plants including species from the families Epacridaceae, Fabaceae, Myrtaceae, Restionaceae and Poaceae for many years.

Since her move to Eastern Australia in 2002, firstly to the University of Melbourne, and then to the University of Sydney, Tina has added fire ecology of Australian native plants to her agenda. She currently researches the effect of fire on plants, fungi and soil and their roles in ecosystem processes. She was awarded a Fulbright Scholarship in 2009 which took her to the University of California Berkeley for three months to research the effects of fire on wine grapevine physiology. Tina supervises a number of local and international postgraduate students who are working in areas of NSW and Victoria.

Tina was awarded an Australian Flora Foundation research grant in 2006 and is the newest member of the AFF Council, having been appointed in May 2011.

Our priorities

In recent years when choosing research projects for funding our priorities have included:

- conservation of Australian plant diversity
- effects of climate change on Australian plants
- potential for cultivation of Australian plant species
- improvements in the cultivation of Australian plants
- protection of rare and endangered Australian plants
- alternatives to harvesting from Australian native ecosystems.

Young Scientist awards for 2010

There were over 100 spoken papers and over 50 posters at the Ecological Society of Australia's Canberra conference, with a good proportion of both being considered for the Australian Flora Foundation Young Scientist prizes.

We congratulate the two winners, who were:

Spoken Presentation – **Sam Wood**, School of Plant Science, University of Tasmania: Age and growth of a Tasmanian temperate old-growth forest stand dominated by *Eucalyptus regnans*, the world's tallest angiosperm.

Poster presentation – **James Camac**, School of Botany, University of Melbourne: Global Warming, Fire & Australian Alpine Plants: Catastrophe or Resilience?

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 research into Australia’s flora. 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.

Impact of climate on the genetic diversity of native species using *Microlaena stipoides* as a model

S. McDonald[1], F. M. Shapter[1], I.Chivers[3] , D.L.E. Waters[1] and R.J. Henry[1,2]
[1] Centre for Plant Conservation Genetics, Southern Cross University.
[2]Queensland Alliance for Agriculture and Food Innovation, University of Queensland
[3] Native Seeds Pty Ltd, Melbourne.

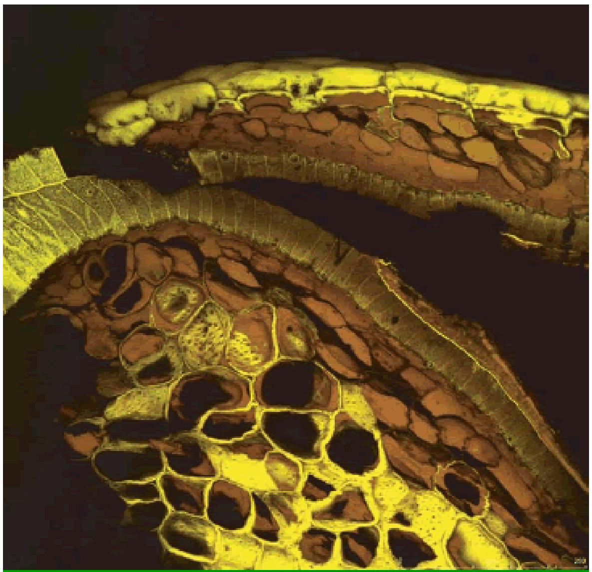
There has been a lot of discussion about the impact that climate change will have on native plant species. There are suggestions that isolated populations will dwindle and die if temperatures increase, and other suggestions that changed temperature and rainfall conditions will be easily accommodated by the native species because they will have experienced these conditions at some stage earlier in their evolution. To address these issues the genetic variability of a model species of native grass, *Microlaena stipoides,* also known as Weeping Grass or Weeping Rice Grass, was examined.

A collection was made across Victoria from naturally occurring populations along an east-west transect that started in central Melbourne, over Mt. Baw Baw and continued on to the Bass Straight coast near Paynesville. Almost 40 distinct populations were collected and assessed for their variability in a gene that is known to be involved in defence against stresses such as fungal attack. The more variable a gene is within a population the more able it is to tolerate varying climatic and other stress conditions.

The results showed several things. Firstly, plants in the high altitude and rainfall zones were less genetically variable than those from the lower altitude and drier conditions. Secondly, plants occurring in those areas that had been subject to disturbance by farming or logging were more genetically variable, and hence flexible, than those that occurred in undisturbed or natural conditions. Thirdly, this model species does not appear to be threatened by changing temperatures and rainfall but indeed has sufficient internal variability to withstand significant climatic change.

These results are consistent with some other wild grass populations seen elsewhere and suggest that those native grasses that are present in drier environments are likely to possess more genetic variability, both within individuals and within populations, than those from higher rainfall zones. The impact of human disturbance on genetic variability within this species is of great interest and is worthy of following through in greater detail. The greater diversity of populations in more marginal environments indicates the importance of conserving these populations and not just those in favourable environments.

Mechanical constraint model of seed coat dormancy in *Grevillea*



Microscope image through the seed coat of a germinating *Grevillea juniperina* seed, showing the fracturing of the layers of the seed coat.

E. Charles Morris and Candida Briggs, School of Natural Sciences, Hawkesbury Campus, University of Western Sydney.

Dormancy of seeds in some East Australian *Grevillea* species is controlled by the seed coat, as excised embryos germinate fully. This project investigated whether the mechanical constraint mechanism of seed coat dormancy applied in *Grevillea juniperina* and *G. linearifolia*. The anatomical basis of breaking of the seed coat by the emerging radicle was investigated using confocal light microscopy. The force required to break through the seed coat was investigated by applying a force from the interior of bisected seed coats (with the embryo removed), in an attempt to simulate the action of the radicle. Compressive forces were applied to seeds from the outside, as a comparison. Both these methods were used on control, and heated and smoked seeds, to determine whether the fire cues affected seed coat strength. The maximum force that the embryos could develop in osmoticum over a range of water potentials was examined for control, and heated and smoked seeds.

The anatomical investigations showed that as the radicle began to grow, it forced apart the inner and outer micropyle, with fractures running between cells, along the cell walls, extending through the layers of the seed coat to the exterior. The tip of the radicle emerged to the outside through the dorsal seed coat near the micropylar tip of the seed, rather than through the tip itself. Estimates of the force required to break through the seed coat from the inside ranged from 0.1 – 0.4 MPa after one day of imbibition; there was no significant difference between the control or treated seeds in the force required. The force required after 14 days of imbibition was slightly less than after one day, but still not significantly different between treatments. The method used to estimate the force required to break through the seed coat from the inside was difficult to implement, and the results must be treated with caution as a result. The compressive force required to break the seed coat after one day of imbibition did not differ with treatment either; however, there was weak evidence of a shift in the shape of the frequency distribution with treatment, which would be consistent with the seed coat of some proportion of heated and smoked seeds being weakened by one or both of the fire cues. More work would be required to substantiate whether this very tentative conclusion is correct. The maximum force that could be exerted by half-excised embryos was at least 0.3 MPa for *G. juniperina*, and at least 0.4 MPa for *G. linearifolia*. The range of water potentials used did not allow determining what the full maximum force was for either species, and whether the fire cues altered this maximum force.

Conclusion

Some limited progress has been made in investigating the mechanical constraint hypothesis of seed coat dormancy in *Grevillea* . The anatomy of the rupturing of the seed coat by the emerging radicle has been characterised. Two methods of estimating seed coat strength have been tried, and only one considered reliable and reproducible. That said, it is interesting that the estimates of the break through force by the (less reliable) pin method (up to 0.4 MPa) matched well the estimates (by the osmoticum method) of the force that the embryos can at least generate (0.3 – 0.4 MPa). The tentative conclusion from the compressive force method, that one or both of the fire cues may weaken the seed coat, is worth further investigation. If substantiated, it will be the first evidence of such a weakening by a dormancy-breaking treatment in any seed. More work is also required with the osmoticum method, to determine both the maximum force that embryos can generate, and whether this is altered by the fire cues, as is the case for dormancy-breaking treatments in other species.

Mycorrhizal associations in the Fabaceae: are they really needed?


Stringybark woodland located within the southwest region of the Glenelg-Hopkins catchment areas near Casterton, Victoria

Tina Bell [1] and Ghazala Yasmeen [2]

[1]School of Forest and Ecosystem Science, University of Melbourne, Creswick, Victoria. Current address: Faculty of Agriculture, Food and Natural Resources, University of Sydney, Eveleigh, NSW

[2]World Forest Institute, Portland Oregon, US

Mycorrhizal associations and root specialisations are beneficial to plants found in low nutrient soils, particularly those characteristic of Australian heathlands and woodlands. Legumes are characterised by the universal presence of N-fixing nodules, but some species have also been reported to have mycorrhizal associations and cluster roots. Seven species of native legumes commonly found in low nutrient heathy woodland ecosystems in south eastern Australia were grown in pot-culture to determine the relative importance of different nutrient strategies in growth, nodulation and nutrient content.

The first pot-culture experiment used soil collected either from the field (unburnt sites with low nutrient capital) or white sand (negligible nutrient content) and with or without a soil P supplement (rock phosphate). All species produced significantly greater above- and below-ground biomass, nodulation was higher (greater number and larger nodules) and N and P content was greater when grown in field soil amended with P. *Viminaria juncea* benefitted more from the presence of cluster roots compared to ectomycorrhizal associations while the remaining species did not produce cluster roots but had ectomycorrhizal associations suggesting a greater contribution from this root specialisation.

The second pot-culture experiment investigated the effect of P supply on plant growth, nodulation and nutrient content. Apart from *Acacia verticillata*, there was no significant difference in above- and below-ground plant biomass with increasing P supply. In contrast, nodule number and weight for *Acacia verticillata* and *A. pulchella* increased significantly with increasing P supply. Phosphorus concentration and content in leaves increased significantly with increasing P in all species but N content did not show the same pattern. Phosphorus supply had a greater effect on the extent of nodulation and presumably, N-fixation than on host plant growth.

From this study it is clear that mycorrhizal associations are required for increased growth and P uptake, and, putative enhancement of N-fixation in the majority of the species studied. Further investigations are required to determine how widespread the occurrence of cluster roots and mycorrhizal associations are in native Australian legumes, and if there is a taxonomic and/or ecological basis to this distribution.

Reproductive biology of the Magenta Lilly Pilly *(Syzygium paniculatum)* and its implications for conservation

Katie A. G. Thurlby[1], [2], William B. Sherwin[2], Maurizio Rossetto[1], and Peter G. Wilson[1]
[1]National Herbarium of NSW, Botanic Gardens Trust, Mrs Macquaries Road Sydney, NSW 2000
[2]School of Biotechnology and BioMolecular Sciences, University of New South Wales, NSW 2052

The Magenta Lilly Pilly (*Syzygium paniculatum*), endemic to a narrow strip along the New South Wales coast, is currently listed as vulnerable at both state and national levels. At present management of the species focuses on minimizing currently known threats, such as weed invasion, while little is known about the reproductive biology of the species. *S. paniculatum* is the only recorded polyembryonic Australian species of *Syzygium;* polyembryony being the development of multiple (and often asexual) embryos in one seed.

Fruit, seed and embryos of *Syzygium paniculatum*. From left to right: the magenta coloured fruit; a single seed with seed coat left on; three embryos all dissected from a single seed.

Nuclear microsatellite markers were used to investigate the genetic outcome of polyembryony on the reproductive and population biology of the species focusing particularly on the population located on The Entrance Peninsular. Low within-population diversity was found, with low heterozygosity levels and a low level diversity indices when compared to other rare or rainforest species. Multiple embryos from single seeds were found to be identical to the mother. Multiple embryos germinated and survived but one seedling was always significantly taller than all others in the seed but was not considered sexual. It was concluded that the rare *S. paniculatum* is an apomictic clonal species with extremely low genetic diversity.

Multiple seedlings of *Syzygium paniculatum* arising from a single seed.

Conservation Implications

The results of this study imply that *Syzygium paniculatum* may have some difficulty adapting to future environmental change. Until now, the species has survived with moderately low overall genetic diversity and extremely low (if any) variation between individuals. This survival is likely to be due to the ability of the species to reproduce prolifically by way of polyembryony and the theoretical fitness of the persistent genotypes in the current environment. It should however be noted, that whilst there is low between-individual variation in the species, the nature of apparent tetraploidy in *S. paniculatum* means that there is high within-individual variation. Nevertheless, the lack of variation between individuals and in the species as a whole, and the apparent asexual reproduction, means that the development of new variation is restricted to the slow process of somatic mutation.

The detection of some sexual reproduction within the species is positive, as it means there is potential within the species to adapt genetically to future environmental change, however the distinct lack of variation particularly at The Entrance suggests that such sexual individuals rarely survive in-situ. It is unlikely that the reduced population sizes and low genetic variation found in *S. paniculatum* are completely due to human interference. However, human activity is likely to have caused significant reduction in the range and population sizes of the species.

From a conservation perspective, there is a need to improve environmental conditions and habitats where practicable, not only to preserve current genetic diversity but to give the species the best possible chance for the accumulation of variation in the future, be that by somatic mutation or sexual reproduction. This particularly applies to the northern populations over southern populations, where the majority of known genetic diversity has been found (Katie Thurlby, pers. comm. 2011). Appropriate activities would include habitat protection and management, weed management, and fire management, plus on-going monitoring and surveying as well as more extensive research. In addition to preserving habitats, in the interest of preserving allelic variation, it may be advisable to introduce each of the various different genotypes found across the species into cultivation to make sure that the variation found within the species is not diluted further by the cultivation of only the most common genotype. Propagation of *S. paniculatum* via seed may be a viable mode of cultivating genetically identical plants as multiple embryos in each seed are easily germinated more reliably than through methods of vegetative cultivation and a high proportion of individuals survive beyond the seedling and sapling stages. Further studies would need to determine the rate of possible sexual events and the practicality of cultivating via seed for large scale production.

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. Donations of $2 and over are tax-deductible.

The Council would like to sincerely thank the following supporters who have recently made donations to the Research Fund:

Australian Plants Society Newcastle Group NSW; Australian Plants Society NSW Region; Australian Plants Society Sutherland Group NSW; SGAP Mackay Branch Qld; Ms B. Buchanan; Prof. H. Clifford; Mr Ian Cox; Dr Rhonda Daniels; Mrs Hazel Dempster; Mr Phillip Esdale; Ms Margaret Esson; Mr Frank Gleason; Dr Peter Goodwin; Dr Jenny Jobling; Dr Margaret Johnston; Mrs E. King; Dr G Kirby; Mr Patrick Laher; Mrs Margaret Lee; Dr Paddy Lightfoot; Dr Geoffrey Long; Dr Peter McGee; Ms Shirley Pipitone; Dr M. Reed; Mr W. Reed; Mr John Scown; Ms Judith Smith; Mr Ross Smyth-Kirk; Mrs Diana Snape; Prof. Acram Taji; Dr Greg Unwin; Dr A. Wheeler; Dr Tim Wood;

More than half of all flowering plant names may be scrapped

Botanists had long believed the accepted number of flowering plant species to be an overestimate, but few are likely to have guessed the scale of the miscalculation. New research suggests that at least 600,000 flowering plant names - more than half - are synonyms, or duplicate names.

Many plant species end up with more than one name, a particularly extreme example being the tomato (*Solanum lycopersicum*), which has about 800 aliases. Alan Paton of the Royal Botanic Gardens, Kew in London, part of the team working to tackle synonymy, says the problem occurs across the plant kingdom. “There are generally about two and a half synonymous names for every accepted name,” he says, adding that widespread and economically important species, such as the tomato, “tend to have more synonyms”.

Historically, the obscure nature of botanical literature has made it difficult for researchers to access all the existing accounts of the groups they are studying, where they might have discovered that the ‘new’ species they had stumbled on, named and described was actually old hat. Even in more recent times, information about plant names is spread around several databases in different parts of the world, and the data have never been gathered in one place before.

Now, after nearly three years of working to weed out synonymy in some of the largest and most comprehensive of these databases, researchers at Missouri Botanical Garden in St Louis and Kew have produced ‘The Plant List’, a definitive working list of all plant species. A survey of plant names on this scale has never been undertaken before because of the huge amount of data involved, but now the use of an automated, rule-based system has provided a breakthrough.
“We’ve been merging these databases, but there are conflicts,” says Paton. “You have to decide which source you prefer. We take global sources in preference to regional ones, and later sources over earlier ones.”

The researchers have downgraded the likely number of flowering plant species from previous estimates of around one million to about 400,000, suggesting that at least 600,000 accepted species names are invalid. The list is currently a first-draft, and work remains to be done before it is truly definitive. “There are other datasets out there that we’d like to get hold of and add to this global dataset,” says Paton.

The team hopes their final list will be published and made widely available to researchers by the end of 2010. “We want to provide something useful quickly because at the moment there is nothing which is globally comprehensive and provides synonyms,” says Paton. “It won’t be perfect, but it will be the best thing there is in one place.”

The creation of such a list was the primary target of the Global Strategy for Plant Conservation, first proposed in 1999 and adopted by 139 nations as part of the Convention on Biological Diversity in 2002. The current draft of ‘The Plant List’ has already been used to help choose which plant species will be included in the Red List Index for Plants - a global analysis of extinction risk.

Source:http://blogs.nature.com/news/thegreatbeyond/2010/09/600000_flowering_plant_names_i.html#more

---

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.

Email Contacts
Peter Goodwin (President): petergoodwin@internode.on.net
Ian Cox (Secretary): itcox@bigpond.com

Australian Flora Foundation Inc.
ABN 14 758 725 506
Box 41 Holme Building
University of Sydney NSW 2006
http://www.aff.org.au/