Date of Publication:
March 2016

Cunninghamia

A journal of plant ecology for eastern Australia

The Royal Botanic Garden Sydney

ISSN 0727-9620 (print) • ISSN 2200-405X (Online)

An observation of adult parasitic wasps (Diapriidae sp.) visiting *Melichrus urceolatus* (Ericaceae) flowers in an endangered woodland remnant

Manu E. Saunders

Institute for Land Water and Society, Charles Sturt University, Albury, New South Wales, AUSTRALIA
msaunders@csu.edu.au

Abstract: *Melichrus urceolatus* R.Br. (family Ericaceae) (Urn heath) is a small shrub endemic to eastern Australia found in open grassy woodlands and heath from southern Queensland to central Victoria. Very little is known of its ecology, particularly in relation to its pollination and reproductive strategies. Most *Melichrus* species are thought to be animal-pollinated, but some floral traits of *Melichrus urceolatus* suggest wind pollination. Here, I describe an observation of parasitic wasps (Diapriidae sp.) found inside *Melichrus urceolatus* flowers in a Box-Gum Grassy Woodland remnant in Albury, New South Wales and discuss the ecological significance of the observation.

***Cunninghamia* (2016) 16: 11-14**
doi:10.7751/cunninghamia.2016.16.002

Introduction

Melichrus urceolatus R.Br. (Urn heath) (family Ericaceae -subfamily Styphelioideae) is a small, prickly shrub endemic to eastern Australia. It is the most common and widespread of the *Melichrus* species, and is found from southern Queensland to central Victoria in patches of the critically endangered White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grassland communities, hereafter Box – Gum Grassy Woodlands (Department of Environment and Heritage 2006). It is a successful post-fire resprouter (Knox & Clarke 2004). This is a common persistence strategy in fire-prone plants that generally develops at the expense of seed set and reproduction (Lamont & Wiens 2003) and could partly explain why it is difficult to propagate *Melichrus urceolatus* from seed (Hawkeswood 1977).

There is very little information on the pollination and reproductive ecology of *Melichrus urceolatus*, although seeds are thought to be dispersed by animals through ingestion of the fleshy drupes (McIntyre et al. 1995). Other species in the ericad subfamily Styphelioideae are thought to be animal-pollinated (Ladd 2006; Johnson 2012). Grant (1949) lists *Melichrus* as a bird-pollinated genus and Lepschi (1993) observed the birds, eastern spinebill (*Acanthorhyncus tenuirostris*) and white-eared honeyeater (*Lichenostomis lecuoyis*) drinking nectar from *Melichrus urceolatus* flowers (therefore potentially acting as pollinators). More recently, flies or bees have been named as the most likely pollinators of *Melichrus urceolatus* (Johnson 2012, 2013). However, *Melichrus urceolatus*' combination of floral traits suggest a more complex reproductive strategy. It produces very small (4-5 mm) pale green to creamy-white urn-shaped flowers, a colour and size trait combination that should make them almost invisible to insect pollinators (Faegri and van der Pijl 1979). In such cases, floral scent and patterns visible under ultraviolet light may compensate by acting as insect attractants (Faegri and van der Pijl 1979), but no information on these characteristics is available for *Melichrus urceolatus*. Flowers produce monad pollen units, a trait common in wind-pollinated plants (Furness 2009), but also have introrse anthers with an appendage at the base, a morphological trait that suggests trigger deposition of pollen onto flower visitors (Paterson 1961; Hermann and Palser 2000). Flowers also bloom from late autumn to early spring when fewer insect pollinators are active, yet they produce large quantities of nectar (Hawkeswood 1977), which is a primary floral attractant for animal pollinators (Faegri and van der Pijl 1979). Here, I report an observation of *Melichrus urceolatus* flower visitation by a parasitic wasp (Diapriidae sp.) and discuss the ecological significance of this observation in light of the plant's floral traits.

Study location and observation

The observation was made in late July 2015 in the Eastern Hill Reserve, an urban reserve in Albury, New South Wales (-36.08332°, 146.936797°, approx. 235 m above sea level). The reserve is a remnant area of Box – Gum Grassy Woodland. Albury experiences hot, dry summers and cool winters. In July, daily temperatures range from a mean minimum of 3.1°C to a mean maximum temperature of 13.1°C and monthly mean rainfall is 65.1 mm. On the day of the observation, the temperature reached 13.8°C (Bureau of Meteorology 2015).

On the afternoon of July 31 2015 I found three *Melichrus urceolatus* plants flowering adjacent to a walking track in the reserve. No other individuals of this species were found nearby. Upon inspection of the flowers, I found two adult parasitic wasps inside two separate flowers (Figure 1). The two wasps appeared to be the same species (later identified as a Diapriidae species by Dr Ken Walker, Museum Victoria -an adult specimen was collected and lodged at Museum Victoria). I watched the wasps for approximately twenty minutes, in which time they remained inside their respective flowers. They moved around inside the corolla very slowly, with frequent periods of inactivity. Both corollae were filled with nectar, but I could not determine whether pollen had been deposited on the wasps' bodies. I returned two days later, and found another individual (or one of the same from the previous observation) inside another flower, exhibiting the same behaviour. I conducted about 8 random observations (5-10 minutes) over the next four weeks at varying times during daylight hours, and did not observe other diurnal insects or birds visiting flowers during those visits.

Discussion

Adults of most parasitic wasp species feed on nectar and pollen and some are important pollinators of Australian flora (Armstrong 1979). Diapriid wasps have been documented as pollinators of orchid species in Japan and North America (Ferguson & Donham 2001; Sugiura & Takahashi 2015), but I could find no record of flower visitation by Diapriidae species in Australia.

My observation raises some interesting questions. *Melichrus urceolatus* is assumed to be animal-pollinated, most likely by flies and bees (Johnson 2012), and flowers produce large quantities of nectar, which certainly acts as an insect attractant. Yet the species also exhibits floral size and colour traits that suggest wind pollination. Is *Melichrus urceolatus* actually wind-pollinated, with insect visitors being merely opportunistic nectar feeders? Or does the species employ both wind and insect pollination (ambophily) as a strategy to guarantee seed set under variable environmental conditions?

Ambophily is not well-understood, but is thought to indicate an evolutionary transition between wind and insect pollination, in either direction. The evolution of wind pollination from animal pollination is more common than the reverse scenario, and generally occurs in response to environmental changes (e.g. climate change or habitat fragmentation) that affect the reliability of insect pollination (Friedman & Barrett 2009). The Box-Gum Grassy Woodlands of eastern Australia are one of the most cleared habitat types in Australia, and numerous studies have documented the effects of habitat fragmentation on the composition of plant communities (e.g. McIntyre *et al.* 2010). Yet there is very little information on pollinator insect communities in these habitats. In particular, it is not known how fragmentation of grassy woodlands affects plant-pollinator networks.

(a) (b)

Figure 1. Lateral (a) and dorsal (b) views of Diapriidae sp. wasp individual feeding inside *Melichrus urceolatus* flowers, Albury New South Wales.

Species in the ericad subfamily Styphelioideae are assumed to be exclusively animal-pollinated, but Ladd (2006) documents a transition from insect to wind pollination in some species of *Richea*, another southern hemisphere Ericaceae genus. Pollen development in the *Melichrus* genus is poorly-understood, but development in other Styphelioideae species, particularly the formation of pseudomonads, is very similar to that of the Cyperaceae, a predominantly wind-pollinated family (Furness 2009). Interestingly, recent evidence has shown that ambophily is more widespread in the Cyperaceae than previously thought, and likely indicates a transition from wind to insect pollination (Wragg & Johnson 2011). In some plants, ambophily can be a facilitative mechanism, whereby insect visitation facilitates wind pollination by triggering pollen release (e.g. Pierre et al. 2010; Mangla & Tandon 2011), which may partly explain the trigger-like anther appendage in *Melichrus urceolatus* (Paterson 1961).

This observation has highlighted an interesting combination of floral traits in *Melichrus urceolatus* and a paucity of information available on its ecology. Further detailed studies are necessary to understand pollination in this species. Evidence of ambophily in *Melichrus urceolatus* would provide an opportunity to investigate this poorly-understood pollination strategy, especially in relation to its evolutionary role under conditions of climate and land use change. Alternatively, strong evidence that *Melichrus urceolatus* is insect-pollinated (as has been suggested) including identification of the key pollinators across its geographical range, would increase understanding of how fragmentation of grassy woodlands impacts plant-pollinator networks. Regardless of its pollination syndrome, the role of *Melichrus urceolatus* as a rich source of winter nectar means it could play an important role in supporting pollinator insect communities in endangered Box-Gum Grassy Woodlands.

Acknowledgements

Thank you to Dr Ken Walker for identification assistance, and to the Editor and an anonymous referee who helped to improve an earlier version of this manuscript.

References

Armstrong, J.A. (1979) Biotic pollination mechanisms in the Australian flora – a review. *New Zealand Journal of Botany* 17:467-508.

BOM (2015) Climate summary statistics Albury Airport AWS, Station number 072160. URL: http://www.bom.gov.au/climate/averages/tables/cw_072160.shtml Accessed 1 November 2015.

Department of Environment and Heritage (2006) White box - yellow box - Blakely's red gum grassy woodlands and derived native grasslands. Nationally threatened species and ecological communities guidelines, EPBC Act policy statement. URL: https://www.environment.gov.au/epbc/publications/white-box-yellow-box-blakelys-red-gum-grassy-woodlands-and-derived-native-grasslands.

Faegri, K. & van der Pijl, L. (1979) *The Principles of Pollination Ecology*. Third Edition. Pergamon Press, Oxford, 244p.

Ferguson, C. & Donham, K. (2001) Parasitic wasp (Hymenoptera: Diapriidae) pollination of a protected North American slipper-orchid *Cypripedium fasciculatum* (Orchidaceae). 2001: An Entomological Odyssey of ESA, 12 December 2001, San Diego CA.

Friedman, J. & Barrett, S.C.H. (2009) Wind of change: new insights on the ecology and evolution of pollination and mating in wind-pollinated plants. *Annals of Botany* 103:1515-1527.

Furness, C.A. (2009) Pollen Evolution and Development in Ericaceae, with Particular Reference to Pseudomonads and Variable Pollen Sterility in Styphelioideae. *International Journal of Plant Sciences* 170:476-495.

Grant, V. (1949) Pollination systems as isolating mechanisms in angiosperms. *Evolution* 3:82-97.

Hawkeswood, T.J. (1977) The Genus Melichrus RBr. *Australian Plants* 10:36-39.

Hermann, P.M. & Palser, B.F. (2000) Stamen development in the Ericaceae. I. Anther wall, microsporogenesis, inversion, and appendages. *American Journal of Botany* 87:934-957.

Johnson, K.A. (2012) *Pollination Ecology and Evolution of Epacrids*. PhD Thesis, University of Tasmania.

Johnson, K.A. (2013) Are there pollination syndromes in the Australian epacrids (Ericaceae: Styphelioideae)? A novel statistical method to identify key floral traits per syndrome. *Annals of Botany* 112:141-149.

Knox, K.J.E & Clarke, P.J. (2004) Fire response syndromes of shrubs in grassy woodlands in the New England Tableland Bioregion. *Cunninghamia* 8:348-353.

Ladd, P.G. (2006) Is there wind pollination in the southern heaths (Styphelioideae, Ericaceae)? *Botanische Jahrbücher* 127:57-67.

Lamont, B.B. & Wiens, D. (2003) Are seed set and speciation rates always low among species that resprout after fire, and why? *Evolutionary Ecology* 17:277-292.

Lepschi, B.J. (1993) Food of some birds in Eastern New South Wales: Additions to Barker & Vestjens. *Emu* 93:195-199.

Mangla, Y., & Tandon, R. (2011) Insects facilitate wind pollination in pollen-limited *Crateva adansonii* (Capparaceae). *Australian Journal of Botany* 59:61-69.

McIntyre, S., Stol, J., Harvey, J., Nicholls, A.O., Campbell, M., Reid, A., Manning, A.D. & Lindenmayer, D. (2010) Biomass and floristic patterns in the ground layer vegetation of box-gum grassy eucalypt woodland in Goorooyarroo and Mulligans Flat Nature Reserves, Australian Capital Territory. *Cunninghamia* 11:319-357.

McIntyre, S., Lavorel, S. & Tremont, R.M. (1995) Plant life-history attributes: their relationship to disturbance response in herbaceous vegetation. *Journal of Ecology* 83:31-44.

Paterson, B.R. (1961) Studies of floral morphology in the Epacridaceae. *Botanical Gazette* 122:259-279.

Pierre, J., Vaissière, B., Vallée, P. & Renard, M. (2010) Efficiency of airborne pollen released by honeybee foraging on pollination in oilseed rape: a wind-insect assisted pollination. *Apidologie* 41:109-115.

Sugiura, N. & Takahashi, H. (2015) Comparative pollination biology in two sympatric varieties of *Cypripedium macranthos* (Orchidaceae) on Rebun Island, Hokkaido, Japan. *Plant Species Biology* 30:225-230.

Wragg, P.D. & Johnson, S.D. (2011) Transition from wind pollination to insect pollination in sedges: experimental evidence and functional traits. *New Phytologist* 191:1128-1140.

Manuscript accepted 21 December 2015