News from the Australian Seed Bank Partnership

The news from the ASBP focuses on a project that identified invertebrate pollinators associated with a collection of native species from the critically endangered Cumberland Plain Woodland community in Western Sydney.

The project demonstrates that targeted plantings of locally adapted, native plant species could increase floral resources for resident pollinator communities. Greening Australia's large scale seed production area was the basis for the work and demonstrates the valuable research and training opportunities generated through this type of production.

Restoration of native wildflower patches in agronomic settings for diverse and healthy pollinator populations

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Globally, about 88% of angiosperms rely on animal pollinators to set seed and reproduce (Ollerton *et al.* 2011). Pollination is therefore a critical ecosystem service, underpinning plant reproductive success and, for crop species, associated yields. Many horticultural crops, including the economically and locally important apple industries, are reliant on insect pollination (Rogers *et al.* 2014). Yet while there is a wide range of native pollinating insects (including wasps, bees, flies, butterflies, hoverflies and ants; Figure 1) most agronomic systems focus heavily on a single pollinator – the European Honeybee (*Apis mellifera*). Honeybee hives are typically brought onto farms for specific crop flowering periods, a practice that has not only high financial costs to farmers, but a high risk associated with dependence on a single pollinator, especially in the context of disease threats (notably Varroa Mite) to this species. Moreover, many fruit crops get added benefits from pollination by wild pollinators, even when Honeybees are abundant (Garibaldi *et al.* 2013). Hence it is vital to support resident pollinator populations in cropping landscapes.

Prolifically flowering native species can provide valuable floral resources for wild pollinators, offering a varied diet of diverse pollen and nectar sources. However, the quantity and quality of nectar and pollen reward can vary significantly between plant species and, for certain insect species, foraging specialisation coupled with adaptations to specific floral morphologies can limit realised resource availability. This highlights the importance of having a broad range of native flowering plants within the landscape to support diverse pollinator assemblages.

Figure 1. A range of native pollinators observed on flowers of Cumberland Plain Woodland floral species during the study. From top left to bottom right: ant (*Myrmecia* spp.) on *Calotis lappulacea*, hoverfly (*Simosyrphus grandicornis*) on *Calotis cuneifolia*, Peacock Carpenter Bee (*Xylocopa bombylans*) on *Senna barronfieldii* and fly (*Diptera* spp.) on *Ranunculus lappaceus*. Photos: Lena Alice Schmidt

Despite this, native vegetation across the Greater Sydney Region is still being cleared to make way for housing, infrastructure and agriculture. This widespread habitat loss and fragmentation is associated with ongoing loss of native floral resources with knock-on effects for pollinator health, diversity and abundance.

Within highly modified landscapes, local enrichment of native plant species that provide diverse floral resources over a substantial part of the year could play a vital role in maintaining and improving wild pollinator population sizes and health. Although mass-flowering farm monocultures (*e.g.,* Canola (*Brassica napus*)) offer insects a short-term bountiful resource, these landscapes typically have few floral resources outside of these short flowering windows. Targeted plantings of locally adapted, native plant species which flower progressively throughout the year could increase floral resources for resident pollinator communities, especially outside of crop flowering times. However, relatively little is known about how different Australian pollinator groups exploit and benefit from the floral resources available across the landscape, or how plant species differ in their relative contributions to resource provisioning throughout the year.
Species selection for native floral enhancements, and therefore their success in supporting native pollinators, depends largely on the floral traits and flowering phenology of the plant species, and foraging preferences of the pollinators. Other contributing local factors include pollinator community species composition, microclimate and landscape context, specifically the amount and quality of floral resources available within the local landscape matrix (Prýs-Jones and Corbet 1991, Mader *et al.* 2011).

To evaluate which native species might be suitable for enhancement plantings, we quantified floral traits, and surveyed pollinator visitation rates, for a range of phylogenetically and morphologically diverse native plant species (Figure 2). For this, we worked with species belonging to the critically endangered Cumberland Plain Woodland (CPW) vegetation community. Our study site was the Greening Australia Cumberland Seed Production Area (SPA) located at the Hawkesbury Campus, Western Sydney University, NSW, Australia (33°36'31.9"S 150°44'20.8"E).

From April 2018 to May 2019, we surveyed flower abundance and associated pollinator visitation, developing a floral calendar for 41 herbaceous species and also collected nectar and pollen samples to evaluate floral reward quantity and quality. We were able to quantify the temporal dynamics of floral resources year-round, thus identifying when resident pollinators may face food shortages. Plant species differed in the length and timing of their floral windows, with year-round flowering observed for only a few (*e.g., Goodenia hederacea*). While a large proportion

Figure 2. Varying morphological traits of a subset of Cumberland Plain Woodland floral species selected for the study. From top left to bottom right: *Plectranthus parviflorus*, *Chrysocephalum apiculatum*, *Rhodanthe anthemoides*, *Senna barronfieldii*, *Linum marginale*, and *Arthropodium* sp. B. Photos: Lena Alice Schmidt

of species flowered for periods of six to seven months (*e.g., Wahlenbergia communis*), others showed a much more restricted floral window (*e.g., Bulbine bulbosa,* which flowered for only three months). Peak flower abundance differed between species, with some species experiencing double peaks in their flowering phenology (*e.g., Pimelea spicata*). Analysis of flower visitation data will allow us to determine whether pollinator visits simply track flower abundance or whether there is evidence of species-specific foraging preferences. These data will also provide valuable insights into which floral traits are associated with the greatest diversity and abundance of pollinator visitation.

From these 41 species we have selected a subset of 23 that successively flower throughout the year and represent diverse morphological traits, including various flower colours and sizes, and nectar quantities. These provide year-round continuity of resources, and have been shown to attract a diverse array of native pollinators. We have now established plantings (floral strips) to test differences between native and non-native (exotic) species (where non-natives typically have a shorter flowering window) in terms of attracting and provisioning native pollinators (Figure 3). For this, we are conducting pollinator observations every month over the course of one year. Our aim is to determine which species are most important for providing floral resources to resident pollinator communities, and how their relative contributions to resource provisioning changes throughout the year.

Native floral strips have the following species composition: *Arthropodium* sp. B, *Calotis cuneifolia*, *Calotis lappulacea*, *Chrysocephalum apiculatum*, *Convolvulus erubescens*, *Coronidium scorpioides*, *Craspedia variabilis*, *Dianella longifolia*, *Dichopogon fimbriatus*, *Geranium solanderi*, *Hypericum gramineum*, *Linum marginale*, *Murdannia graminea*, *Plectranthus parviflorus*, *Podolepis jaceoides*, *Rhodanthe anthemoides*, *Senecio quadridentatus*, *Senna barronfieldii*, *Viola betonicifolia*, *Vittadinia cuneata*, *Wahlenbergia communis* and *Wahlenbergia gracilis*. Exotic floral strips include 23 non-native species from a commercially available bee and butterfly flower mix.

Our study tests the role that native floral enhancements can play in supporting diverse and healthy pollinator populations across Australian landscapes. This, we hope, will support the reintroduction of native plant species, including those belonging to critically endangered communities, into agricultural landscapes. The restoration of small patches of species-rich native vegetation has the potential to provide refuges and resources over prolonged periods, helping to increase local biodiversity. In agronomic settings such floral enhancements can attract beneficial insects for pollination services, and assist with the control of pest species by providing habitat and resources for predator and parasitoid populations (Long *et al.* 1998).

Figure 3. A floral strip comprised of Cumberland Plain Woodland plant species, established as part of targeted native floral enhancement studies. Photo: Lena Alice Schmidt

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