Pollination biology in *Ptilotus*

For millions of years, animals and flowering plants have had a special relationship, evolving in tandem with the goal to maximise their own fitness. Flowering plants developed a key innovation – the flower – that enabled them to attract animals that could disperse their pollen to a plant of the same species. This led to the co-evolution of many animal groups and flowering plant groups, increasing the reproductive fitness of both the animal and plant species. Among flowering plants, the flower is one of the most diagnostic features of the plant, possessing many characters that have varied over the course of evolution, some influenced by the behavior of the pollinator. By studying these relationships we can learn about pollination biology, which can inform conservation and guide our land management practices.

Species of a large group of arid Australian plants – the mulla mullas (genus *Ptilotus*) – vary widely in the morphology of their flowers, colour, size, and number and orientation of the stamens, among other characters. These variations are a fascinating subject of study, to discover the reasons why the floral morphology of closely related species would vary so much.

A common strategy used by flowers is called the 'generalist syndrome', where the flower has no obvious adaption towards a specific pollinator. Using this strategy, the flower can be accessed by a variety of pollinators and there is no selection pressure to evolve a specialised flower shape. One example of this within mulla mullas is *Ptilotus grandiflorus*, which has a dish-like flower that has all of its parts radially symmetrical. There's no obvious orientation, and its general pink color can be seen by many types of insect pollinators. The stamens are small and close to the location of the stigma, so it doesn't seem to matter where the pollen is placed on the pollinator. Flowers of *Ptilotus grandiflorus* are often visited by wasps, but multiple species of butterfly, and a bee fly have also been observed working the flowers.

Colour and floral orientation are very important in attracting pollinators and maximising the potential for successful pollen dispersal. The hairy mulla mulla (*Ptilotus helipteroides*), has four stamens with pale pink filaments in a square pattern. The obsolete fifth stamen is a long staminode, which is decorated with bright orange at the base with an orange frilly staminal cup that indicates where the nectar is found. The flowers of *Ptilotus* are protandrous, which means the pollen dehisces (discharges) before the stigma becomes receptive. After the flower opens, the pollen dehisces from the anthers when they are at the center of the gaping flower. As the flower ages, the stamens move apart, and the style with the receptive stigma moves toward the center of the flower. This appears to facilitate pollination by orientating the pollinator in a specific position for the optimal placement of pollen.

A more specialised strategy has been identified in *Ptilotus polystachyus*, which is a common species throughout Australia with tall green inflorescences. The flowers are night opening, when they are also sweetly scented. Older flowers at the base of the inflorescence close with the style hanging out with a receptive stigma. Moths have been observed to land at the base of the inflorescence, coated with pollen, and make their way up the stalk, presumably pollinating the stigma of older flowers. Once near the top, they probe the ring of open flowers for nectar and drink. They then pick up the pollen for the open flowers and fly to the next plant. This is one of the methods of moth pollination in *Ptilotus* and a way that pollinator behaviour has shaped both floral display and inflorescence structure.

So much still remains to be learned about the pollination biology of *Ptilotus* and other arid Australian plants, but it is clear that many of the flowers that we enjoy, and are so important for tourism, are due to their animal pollinators and the special relationships they share.

Above A *Ptilotus grandiflorus* is visited by a wasp.
Photo – Robert Davis/Parks and Wildlife