

This article on pollination was written by the Australian Museum in Canberra.

Pollination

Pollination is the process by which plants sexually reproduce. Many plants depend on insects to transfer pollen as they forage. Plants attract insects in various ways, by offering pollen or nectar meals and by guiding them to the flower using scent and visual cues. This has resulted in strong relationships between plants and insects.

- [What is pollination?](#)
- [How important is insect pollination?](#)
- [Why is pollination by insects important for the environment and us?](#)
- [Which insects are pollinators?](#)
- [How do insects pollinate plants?](#)
- [How does flower shape affect pollinators?](#)
- [How do plants attract pollinators?](#)
- [References](#)

What is pollination?



A leaf cutter bee manages to cover itself in pollen. Photo: © D Nelson.

Pollen is made by the male organs of a plant (anthers in flowers) and contains genetic information needed for plant reproduction. Pollination is the delivery of pollen to the female organs of a plant (stigmas in flowers).

Pollen may be transferred to female organs on the same plant (self-pollination) or another plant of the same species (cross-pollination). As a result of pollination the plants produce seeds. Pollen can be dispersed by wind, water and animal pollinators such as insects, bats and birds.

How important is insect pollination?

It is estimated that 65% of all flowering plants and some seed plants (e.g. cycads and pines) require insects for pollination. This percentage is even greater for economically important crops that provide fruits, vegetables, textile-related fibres and medicinal products. Because insects are such efficient pollinators, plants have developed many

ways of encouraging them to visit. This has led to some strong associations between plants and insects.

Why is pollination by insects important for the environment and us?

1. Pollination by insects is a much more reliable and efficient pollination mechanism than chance dispersal.
2. Pollination by insects determines plant community structures.
3. Pollination by insects is particularly important for Australian native trees and shrubs. For example, native bees pollinate many members of the plant family Myrtaceae. This plant family includes eucalypts, angophoras and tea trees.
4. Pollination by insects is vital for crop production. One third of the human food supply is crops that are dependent on pollination by bees.

Which insects are pollinators?



A fly rest on anthers as it uses it sponge-like mouthparts to absorb the nectar. Photo: © M Batley.

Species of bees, beetles, flies, wasps, thrips, butterflies and moths are all successful pollinators.

These insects make good pollinators because they share two important features:

- They fly, and so are capable of visiting many plants in a relatively short amount of time
- They are motivated to interact with pollen, as they either eat it or food items located nearby (e.g. nectar).

The most sophisticated relationships between plants and insects are generally those involving bees. Bees collect pollen and nectar not only for themselves but also to feed their young. For this reason bees have developed a number of adaptations that make them particularly good pollen carriers. Bees have special hairs that are arranged to form pollen 'baskets' on their hind legs and the underside of their abdomen. These adaptations allow them to gather and carry large volumes of pollen. Bees are ideal pollinators because they visit many flowers while carrying lots of pollen, before returning to their nest. So the chance that a bee will transfer the pollen between flowers of the same species is very high.

How do insects pollinate plants?

Pollination by pollen-feeders



A beetle collects pollen on its body as it feeds. Photo: © D Nelson.

Many insects eat pollen. In the process of eating they become covered in it. Pollination happens when the pollen feeder transfers the pollen to the pollen receivers of the same plant, or another plant of the same species, as the insect looks for more pollen to eat.

Disadvantages of attracting a pollen feeder:

- They eat the very item the plant wants delivered - pollen.
- They tend to be generalist feeders and eat other parts of the plant, including the sexual organs.
- They could be considered to be 'unreliable pollinators' as the pollinator might not go anywhere near the female organs of the same species of plant.

Pollination by nectar feeders



A bee resting on hidden anthers as it feeds on nectar. Photo: © D Nelson.

The majority of flowering plants encourage insects to visit their flowers by secreting a sugar-rich liquid called nectar. This nectar collects in pools, below the sexual organs of the plant. As the insect enters the flower in search of nectar it brushes against the anthers (pollen bearing male parts of the flower). In doing so the insect collects the pollen, as it sticks to its body. When the insect visits another flower for more nectar, the

pollen is transferred from its body to the stamen (pollen receiving female parts of the flower), causing pollination.

Pollination by a nectar feeder has a number of possible advantages including:

- The locality of the nectar ensures the insect cannot avoid touching the organs associated with pollination.
- Pure nectar feeders such as butterflies and moths do not eat the pollen.

How does flower shape affect pollinators?



A bee using its long tongue (silhouette through side of flower) to access the nectar at the base of a flower with a long tubular head. Photo: © M Batley.

Flower shape can restrict access to pollen and nectar to only those insects that have the appropriate tools or abilities. For example, the nectar at the base of a long tubular flower may only be accessed by insects that have long mouthparts such as butterflies, moths, flies and bees that have long lapping 'tongues'.

The flower shape can be so restricting that a certain type of behaviour maybe required to access the pollen. For example, 'buzz pollination' is needed to pollinate many *Hibberta* species. It is practiced by the Blue Banded Bee and a number of native Australian carpenter bees, and involves the bee holding onto the plant and vibrating to get the pollen out.

The relationship between flower shape and the location of the nectar is also used by plants to attract certain insects. Many legumes (e.g. Lucerne), have concealed nectar that can only be accessed by large, strong bees like Leaf Cutter or Resin Bees. The flowers of these plants are closed. It is only by pushing down on the lower parts of the flower that the it opens up to allow access to the nectar. As the flower springs open pollen is flung onto the under body of the bee.

How do plants attract pollinators?



Cycads found in central Australia rely on thrips for pollination. The thrips are attracted by scent, which is then used to direct the insects to male and female cones. Photo: M Bulbert © Australian Museum.

Simply supplying nectar does not guarantee that the insect will come to a plant or transfer pollen to the pollen receivers of the same species. For this reason, plants use visual and scent cues to attract and direct insects.

Scent is an effective way of luring pollinators. For example, strong smelling flowers tend to be visited by beetles and flies, while bees and butterflies visit sweet smelling flowers. It is also an effective means of directing pollinators to the pollen receivers.

Cycads from inland Australia use scent to lure thrips for pollination. Thrips are very small insects that cannot carry many pollen grains, so the plant needs to attract large numbers of them. A male cycad cone laden with pollen will emit a strong and pungent scent that will attract as many as 50 000 thrips. Female cones also emit a scent once they are ready to receive pollen, which then attracts the pollen-laden thrips.

Scent can also be used to trick insects into becoming pollinators. The Corpse Flower of Indonesia uses a pungent odour of rotting flesh to attract carrion insects. The Australian Broad-lipped Orchid imitates the scent and also the appearance of a female Thynine Wasps. This fools male wasps into attempting to mate with the flower which is pollinated in the process.

References:

- Bernhardt P. Anther adaptation in animal pollination. *The Anther. Form, Function and Phylogeny* (eds W.G. D'Arcy & R.C. Keating), pp. 192-220. Cambridge University Press, Cambridge
- Brunet, Bert, (2000). *Australian Insects: A Natural History*, Reed New Holland, Sydney.

- Cunningham S.A., FitzGibbon F., and Heard T.A. (2002) The future of pollinators for Australian agriculture. *Aust. J. Agric. Res.* 53: 893-900.
- Gullan, P.J. and Cranston, P.S. (2004). *The insects: an outline of entomology.* Blackwell Publ.
- New T. (1988) *Associations between insects and plants.* NSW University Press.
- Rod Peakall (2003) *Pollination by Sexual Deception in Australian Terrestrial Orchids* http://online.anu.edu.au/BoZo/orchid_pollination/
- Schwarz M.P. and Hogendoorn K. (1999) In "The other 99%. The conservation and biodiversity of invertebrates". (Eds) W. Ponder and D Lunney. *Transactions of the Royal Zoological Society of New South Wales, Mosman.* pp: 388-93.
- Schiestl, F.P., Peakall, R., Mant, J.M., Ibarra, F., Schulz, C., Franke, S and Francke, W. (2003) The chemistry of sexual deception in an orchid-wasp pollination system. *Science* 302, 437-438.
- Terry I. 2002. Thrips: the primeval pollinators? In: *Thrips and Tospoviruses: Proceedings of the 7th International Symposium on Thysanoptera* (eds R Marullo & LA Mound), pp. 157-162. Australian National Insect Collection, Canberra, Australia.
- Yen, A and Butcher R, (1997). An overview of the conservation of non-marine invertebrates in Australia, Environment Australia.

Footer information



Copyright © Australian Museum 2005

australian museum online

about the museum

research & collections

features

explore