Orchids and Wasps

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To most of us the word 'flower' suggests certain attributes such as bright colour, fragrance and insects or birds searching for food. Western Australia is unusually rich in such flowers and we tend to be less aware of the duller colours and smaller size of those which attract less familiar insects or utilize wind for pollen transport. Many of the native terrestrial orchids are brightly coloured and often fragrant but others are dull in colour and odourless to man. Among the latter group are some with an unusual method of pollination: they attract male wasps by releasing chemical attractants simulating the sexual odour of female wasps.

Many insects utilize a chemical language conveying specific messages indicating warning, aggression, food, trail marking and sex. These substances are called pheromones and are specific for each insect species i.e. a compound utilized by one species is not detected by others. In Western Australia, flowers of some orchid species release sexual attractants for specific wasps. We do not know whether these attractants are identical to those of the target insect or merely induce similar behaviour. Flowers of these orchids chemically simulate female wasps, and searching males visiting the flowers transport pollen from one pseudo-female to another.

Orchids mimicking female wasps occur elsewhere, especially around the Mediterranean and in southern Europe, but they are best represented both in number of species and in floral diversity in southwestern Australia where about twenty-five species are known to occur. The Australian pheromone-utilizing orchids exploit three families of primitive wasps. The southwestern tongue orchid *Cryptostylis ovata* attracts male *Lissopimpla* wasps of the Ichneumonidae as do other *Cryptostylis* in the eastern states. The southwestern beard orchid *Calochilus robertsonii* is largely self pollinating, although Andrew Brown (W.A. Herbarium) has observed it attracting wasps, presumably of the family Scoliidae. This wasp family is exploited by eastern Australian *Calochilus* species. Most wasp-mimicking orchids of the southwest utilize male wasps of the family Tiphiidae, subfamily Thynninae. These sexually dimorphic insects have small wingless females superficially resembling ants and much larger winged males.

Wasp visits to Australian orchids were reported early in this century although the mechanism was not explained until Edith Coleman described male *Lissopimpla* wasps attempting to mate with flowers of several *Cryptostylis* species in a series of papers beginning in 1927. Since then, others have observed a variety of orchid species using sexual lures for wasps.

▼ Three male *Lissopimpla* wasps on the lip of *Cryptostylis ovata*.

Thynnid wasps are especially exploited by orchid flowers. In some species the flowers are the dimensions and general colour of female wasps but in others only generalized form and colour coupled with the appropriate attractant bring about pollination. The mating behaviour of these wasps lends itself to exploitation by the orchids. Wingless female thynnids perch on low vegetation and release pheromonal attractants into the airstream. Searching males follow the odour trail upwind to the source. At close range a wasp orientates visually to a female, picks her up, and carries her to a perch where she is simultaneously fed and fertilized. Some males offer material previously collected from flowers, while others carry the female to flowers where both feed while mating. The initial perching behaviour of an advertising female on low vegetation is simulated by orchids, where a decoy is placed at the end of a thin, flexible stem.

The chemical attractants are produced by specialized parts of the flowers and are specific for the target insect species. Attractants are produced by the sepal clubs of some spider orchids and by the head-like portion of a hammer orchid, but odour source has not been determined for most species. In the butterfly spider orchid of the southwest three sepal clubs with a combined length of 30-40mm produce the sex lure. A 2mm section of one of these clubs is sufficient to attract receptive male wasps.

Orchid attracted wasps search for females on the flower and in some cases attempt to pick up and mate with the pseudo-female. Orchid pollen adheres to the wasp during the visit and the insect transfers this to the stigma of another flower as it repeats its search for a female. The plant's reproductive cycle is completed by this subterfuge but the wasp gains nothing. In many nonsocial wasps such as these the males emerge before females. The orchids are assumed to exploit this difference in emergence time without seriously interfering with normal wasp reproduction. Such assumptions need investigation, however. We know surprisingly little of the biology of these insects.

▲ Male thynnid wasp alighted on decoy lip of an undescribed hammer orchid.

▼ Wasp has attempted to remove the decoy and has fallen into the stigma and anther.

This orchid-wasp association raises many questions about origin and evolution, about biochemistry of the attractants, about costs and benefits of the models and the mimics, and about the reasons for its extensive development in southern Australia but its virtual absence from most of the earth.