# Sex and the Singular Orchid

*February speaker Jeff Baylis has been "killing orchids since he was 14." He is a retired Zoology professor and his training in animal behaviour serves him to love orchids not only for their beauty but for their diverse strategies of manipulating insects for reproduction.*

Orchids have long been associated with sex. The genus name comes from the ancient Greek word for "testicle" (orchis), because of the shape of the twin tubers in some species. The physical appearance of certain plants was believed to be associated with their curative properties for humans. The European terrestrial Orchis had two tubers and because of this characteristic, they were associated with testicles. Therefore it was assumed that these tuber had beneficial results for human fertility virility, etc. This talk was discuss the close reproductive association orchids have with 'animals'.

*Orchis italica*
Woodcut from John Parkinson, Theatrum Botanicum. (London: 1640). The individual flowers of this Mediterranean orchid have an extraordinary resemblance to miniature well-endowed satyrs. Together with the two testis-like tubers this feature must have led early physicians to believe that plants of this kind could be used as love potions [redacted]

**What are Orchids?**

Orchids are Monocots and occur on all continents except Antarctica. They are found in most environments including deserts and they rarely if ever dominate habitat. They are species rich and by some accounts, the largest family of flowering plants with between 25,000 to 30,000 species. They are defined by threepart symmetry of flowers with three sepals and three petals. The stigma and stamens are fused into a single column. The middle petal, which is always opposite the column is called the lip or labellum. It is usually quite different from the others and comes in a variety of shapes. To discourage self-pollination, the male pollinia typically are separated from the stigma (female part of the flower that receives the pollen) by a flap of tissue called the rostellum. The rostellum also aids in the transfer of the pollinia from the pollinator to the stigma. The evolutionary rise of flowering plants and the rise of insects have occurred together in evolutionary time, and some botanists have described insects as 'a benign venereal disease ' of plants because of their role in plant reproduction.

While almost all 'flowering plants' require insect pollinators, orchids have an unusually specific relationship with their pollinators. Unlike other flowering plants, pollen is often in a discrete mass or 'packaged' in pollinia carried locally by animals. Fertilization is often 'monogamous' - all seeds in a pod produced from a single male parent. Seeds are very tiny and broadcast by wind. Seeds require a fungal host to germinate and grow as they have no independent food source. Their pollinaria are formed to 'out-cross' and avoid self-fertilization. Pollination always requires an animal intermediary, except in cases of selfing species.

Most orchids require a specific insect species to pollinate them and despite the thousands of

species of orchids, little is known about what the insect is. Orchids typically have exclusive relationships with their pollinators. The origin of orchids may be linked to the evolution of the Hymenoptera (bees, ants, wasps), especially the social Hymenoptera. Many orchids may utilize flies, moths, butterflies, fungus gnats, or birds to cross-pollinate their flowers. Evidence suggests that orchids and insects evolved together. A fungus gnat with a pollinaria affixed to its leg entombed in amber has been dated from 45 – 55 million years ago. Another example was of a wasp with pollinaria on its back 20 to 30 million years ago. Although neither the wasp or orchid are in existence today, they have modern descendants.

Orchids flowers use simple stimulus-response rules of insect behavior to accomplish pollination with out-crossing even at the alleged cost of reduced pollination. [1] Fertilization requires the insect to visit flowers of the same orchid species at least two times, and fertilization is rare and as a result orchid flowers tend to be long lasting. Some orchids lure their pollinators through sexual deception through appearance or the use of a species-specific chemical attractant. Others may produce flowers that look or smell like they offer food, but offer no edible reward. There are many examples of insect 'pseudo-copulation' with orchids flowers; all involve male bees, male wasps, or male ants.

**Third sex**

In 1922, Louis Knudson discovered that nearly 100 percent germination could be achieved by starting seeds in flasks on sterile media fortified with nutrients. Some years later the process of mericloning was developed, allowing the mass production and marketing of individual cultivars. Thanks to these achievements, — presently more than 100,000 have been registered—today orchids are produced by the millions. They are now among the most widely grown and popular flowering pot plants in the world. Today orchids heavily rely on man for reproduction. Florian P. Schiestl [1] and his team observed populations of 31 orchid species with varying pollination strategies in Italy and Western Australia. They measured the amount of pollen that was taken from each orchid, and the amount of pollen that made it to its intended destination -- another orchid of the same species.

They found that populations of sexually deceptive orchids had higher "pollen transport efficiency" than the species with multiple pollinators. In other words, a higher percentage of the pollen that was taken from sexually deceptive orchids actually made it to another orchid of the same species. The orchids with multiple pollinators had more pollen taken from their flowers, but more of that pollen was lost -- dropped to the ground or deposited in flowers of the wrong species. So it appears that specializing with one pollinator -- and appealing to it with sex -- makes for a more direct line from one orchid flower to another, with less precious pollen lost in the transport process." These results could provide new insights in the understanding of evolutionary shifts between generalized to specialized pollination strategies in flowering plants," says Scopece, "and that sexy orchids do it better!"

[1] Giovanni Scopece, Salvatore Cozzolino, Steven D. Johnson, and Florian P. Schiestl. Pollination Efficiency and the Evolution of Specialized Deceptive Pollination Systems. The American Naturalist, 2010; 175 (1): 98