Love & Lies: Orchids

The first land plants appeared approximately 443 million years ago & plants have been evolving ever since. One feature that all plants share is their rootedness; that is to say, they are stuck in one place. So how do you spread your genes around when you're stuck in one place? Plants have evolved many different strategies to reproduce. Some plants spread their pollen on wind or water. Others produce nectar that attracts animals and insects. As these organisms feed on the nectar, they gather pollen and carry it to other flowers. A family of flowers, called orchids, contains 25,000 species and has colonized six continents and can live in any type of land habitat (from deserts to rainforest to mountaintops). How have these plants become so successful?

Orchids use a strategy different from many other land plants: deception. Some orchids offer food rewards (nectar) to insects and animals that transfer their pollen to other flowers. But roughly a third of orchid species "figured out" that they can save the expense of producing nectar by using deception. They have evolved to mimic many different organisms: some mimic nectar-producing orchids, some produce nasty scents (from rotten meat to cat urine to baby diaper), some mimic common insect shelters. These orchids all attract pollinators who believe they are getting something from the flower (gnats and flies would be attracted to the ones producing odor, thinking they are getting food, for example). One genus of orchids, *Ophrys*, has evolved the most clever deceit of all…

Ophrys orchids offer no nectar or pollen reward. Rather, it mimics the appearance, scent and tactile (touch) experience of female bees. This "female bee" attracts males who want to reproduce. The male lands on the orchid and attempts to mate with the "female bee". During these attempts, the bee rubs agains the flower's column (which holds the pollen) and pollen sacs are stuck to the bee's back. Eventually, frustration kicks in and he flies off to find a real female, but could find another *Ophyrs* orchid and transfer the pollen to it, ensuring reproduction of the plant.

Read the following excerpt from "Love & Lies: Orchids" from National Geographic Magazine, September 2009, on the evolution of the reproductive strategy of *Ophrys* orchids.

The orchid's pollination strategies do raise challenging questions for evolutionists. Since natural selection seldom rewards the unneccessary complication, why haven't all orchids stuck with the more straightfoward pollination strategies based on nectar reward? And how in the world did their sexual practices get so elaborate? As for the hoodwinked pollinators, what, if anything, do they gain? If the answer is nothing but frustration, then why wouldn't natural selection eventually weed out insects so foolhardy as to spend their time mating with nature's version of the inflatable love doll?

Botanists and evolutionary biologists have come up with fascinating answers to many of these questions. John Alcock, an evolutionary biologist, proposes two explanations for why some orchids would have evolved to avoid a simple nectar reward. When botanists experimented by adding a nectar reward to a normally nectarless orchid, they found that the pollinators hung around longer, happily visiting other blooms on the same and nearby plants. This does not suit the orchid's interests, however, since inbreeding results in lower quality seeds. By comparision, outcrossing, or mixing one's genes with distant mates, increases vigor and variation in one's offspring, increasing chance of survival. The sexual frustration of a deluded bee turns out to be an essential part of the orchid's reproductive strategy. Determined not to make the same mistake again, the bee travels some distance and, if things work out for the orchid, ends up

attemping to mate (and leaving his package of pollen) with an orchid far away. That distanct orchid is likely to look and smell ever so slightly different from the first, and some botanists believe these subtle variations from plant to plant are part of the orchid's strategy to prevent bees from learning not to fall for a flower. "Imperfect floral mimicry" is the botanical term for this adaptation. Think of it: The very imperfection of the orchid's mimicry may itself be part of the perfection of its reproductive strategy.

Another reason so many orchids have gotten out of the restaurant business may have to do with the benefits of developing a relationship with a single, highly devoted pollinator. Nectar, besides being metabolically expensive for the flower to produce, is beloved by so many different animals that it attracts all sorts of riffraff that may not deliver your pollen to the right target. But if you produce a scent that attracts only the males of one particular species of bee, you can insure that your pollen will end up precisely where you want it: on the stigma of a far-flung orchid of your own kind.

Orchids have excelled at spinning off new species, and yet there are remarkably few orchid plants in the world. Their relative rarity in the landscape puts a premium on highly customized pollination strategies to deploy their pollen as efficiently as possible—unlike grasses, for instance, which can simply broadcast their pollen on the wind. Yet their small numbers insure survival. If deceptive orchids were much more common, their ruses would no longer work, since they depend on the large quantities of honest flowers. Orchid deception can succeed only in a world where most things in nature really are what they seem: where the smell of rotting meat signals rotting meat, where flowers really do offer nectar and don't dress up as bugs.

It seems fair to say that when it comes to their own sex, orchids have opted for quality rather than quantity. For while sexual deception doesn't fool all of the pollinators all of the time, it does fool some of them some of the time, and for an orchid that is quite enough.