

Mimicry & Deception in Pollination
Annotated bibliography
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Dafni, A. 1983. Pollination of *Orchis caspia* – a nectarless plant which deceives the pollinators of nectariferous species from other plant families. *Journal of Ecology* 71: 467-474.

In this study of the title species, Dafni contributes to basic knowledge about the nature of deceptive pollination systems and introduces the ideas of pollinators finding it hard to distinguish between a mimic and a model; the lack of nectar in this assumed mimic; as well as the notion that this type of pollination is not the result of co-evolution, per se, but rather evolution of pollinator exploitation by the orchid.

Dafni, A. 1984. Mimicry and deception in pollination. *Annual Review of Ecology and Systematics* 15: 259-278.

This is a seminal paper on the topic, which provides nearly encyclopedic information, without any original experimentation, but with a wealth of examples to describe deceptive pollination syndromes of practically all types. Cited references are extensive.

Ferdy, J.B., F. Austerlitz, J. Moret, P.H. Gouyon & B. Godelle. 1999. Pollinator-induced density dependence in deceptive species. *Oikos* 87(3): 549-560.

This paper reiterates what is known about density-dependence of deceptively pollinated plant, but from the fresh perspective of conservation biology. Using modeling of pollinator learning curves and their effect on the deceptive plant population, the researchers found an Allee effect of positive density dependence at low density, with negative density dependence at higher densities. They theorize there is a threshold density required by the plant population to survive, and using this they demonstrate potential effects of parameters of varying pollinator abundance and habitat fragmentation on survival of the plant population.

Ferdy, J.B., P.H. Gouyon, J. Moret & B. Godelle. 1998. Pollinator behavior and deceptive pollination: learning process and floral evolution. *The American Naturalist* 152(5): 696-705.

These researchers employ modeling methods to evaluate parameters of density-dependence on success of deceptive pollination systems, as well as the ability of pollinators to learn to avoid deceptive flowers. They conclude that these systems are density-dependent, and that morphological variability limits the ability of pollinators to learn to avoid deceptive flowers.

Handel, S.N. & R. Peakall. 1993. Thynnine wasps discriminate among heights when seeking mates – tests with a sexually deceptive orchid. *Oecologia* 95(2): 241-245.

*This study examines the effects of plant height of the deceptive orchid, *Chiloglottis reflexa*, on the preference of its pollinator species, *Neozeloboria nr. proxima*. This orchid mimics female wasp pheromones and appearance. The researchers*

determine by field choice experiments that male wasps prefer to visit low flowers around 15 cm, than flowers at either 55 or 105 cm.

Joel, D.M. 1988. Mimicry and deception in carnivorous pitcher plants (Sarraceniaceae, Nepenthaceae, Cephalotaceae, Bromeliaceae). *Biological Journal of the Linnean Society* 35: 185-197.

This paper demonstrates a scenario that could be mistaken for Batesian mimicry, but extensive evidence provided in this paper indicates otherwise. It details the requirements for Batesian mimicry and systematically lists how these families do not fulfill these requirements. The major problem with this paper is for those of us who are not experts on pitcher plants – the authors rattle off names of plants and it is possible the authors are pulling a sleight-of-hand in asserting their points. For instance, they declare boldly that these families do not demonstrate Batesian mimicry, but apart from their examples, it is possible that many more do. On the other hand, they do make many valid points, and they succeed in making one realize that many of our uneducated assumptions about Batesian mimicry can easily be shown to be wrong.

Johnson, S.D. 2000. Batesian mimicry in the non-rewarding orchid *Disa pulchra*, and its consequences for pollinator behaviour. *Biological Journal of the Linnean Society* 71: 119-132.

*This paper was assigned for class discussion. It details a well-conducted experiment to demonstrate Batesian mimicry in the South African orchid *Disa pulchra* by comparing pollinator behavior on this flower with behavior on the presumed model flower species, *Watsonia lepidota*. The experiment gives a conclusive result of a Batesian mimicry system, and the authors present hypotheses explaining the relationship and its evolutionary advantages for the mimic – ultimately, they claim, by selection for a more efficient mating system. Great study, beautiful graphics.*

Johnson, S.D. & L.A. Nilsson. 1999. Pollen carryover, geitonogamy, and the evolution of deceptive pollination systems in orchids. *Ecology* 80(8): 2607-2619.

This paper explores, somewhat confusingly, the mechanisms of evolution of deceptive pollination syndromes, by quantifying parameters of geitonogamy and pollen carryover for use in understanding how these reproductive strategies affect selection for deception. They conclude that an abundance of pollinators will select for traits preventing geitonogamy, though conclusions as to evolution of deceptive pollination were not firm. They hypothesize, legitimately, that deceptive pollinators are pollination-limited and invest resources into attraction schemes rather than into nectar production.

Kunze, J. & A. Gumbert. 2001. The combined effect of color and odor on flower choice behavior of bumble bees in floral mimicry systems. *Behavioral Ecology* 12(4): 447-456.

These researchers, using a great experimental design, manipulated flowers to compare the effects of display mimicry and odor mimicry on pollination by bumble bees. They found that it is best for a mimic to have the scent of the model, but that this is hard to evolutionarily develop. Also, in the presence of multiple potential models,

scentlessness is a better strategy than producing a scent is. Visual mimicry is enhanced by presence of scent, even if the scent is not necessarily a cue itself.

Roy, B.A. & A. Widmer. 1999. Floral mimicry: a fascinating yet poorly understood phenomenon. *Trends in Plant Science* 4(8): 325-330.

This is a synthesis paper that provides a lot of useful background information about Batesian and Mullerian floral mimicry, while balking at the naïve assumptions people make regarding supposed mimicry systems. They list several requirements, most importantly, that the supposed mimicry must supply a fitness advantage for the mimic. In particular they address the controversy surrounding Mullerian mimicry, which is often not discussed.

Sabat, A.M. & J.D. Ackerman. 1996. Fruit set in a deceptive orchid: the effect of flowering phenology, display size, and local floral abundance. *American Journal of Botany* 83(9): 1181-1186.

*These researchers investigated phenology of fruit set in the deceptive orchid *Tolumnia variegata*, along with other factors. They found strong disruptive selection in phenology, indicating greatest success for very early and very late flowering phenology. Floral abundance also showed an effect, with intermediate abundance resulting in more fruit set per flower than low abundance does. Display size of flower had a weak, but significant effect on fruit set. Overall, results imply that the deceptive flower is most successful if it can maximize on the naïveté of a pollinator, but not stand out so much that it is easily learned.*

Schiestl, F.P. 2002. Odor communication and the evolution of pollination syndromes in orchids. *Bulletin of the Geobotanical Institute* 68(5562): 55-62.

This paper does not show the fruition of any research, but introduces methods the researchers will use to investigate the properties of flower odor used in pollination of orchids, including deceptive orchids. It is useful for the background information they present.

Smithson, A. & L.D.B. Gigord. 2001. Are there fitness advantages in being a rewardless orchid? Reward supplementation experiments with *Barlia robertiana*. *Proceedings of the Royal Society of London, Series B, Biological Sciences* 268(1475): 1435-1441.

Not much research has actually examined the existence of fitness advantages in deceptive pollination syndromes. This paper does that by assessing the fitness of artificially rewarding deceptive flowers compared to naturally non-rewarding flowers of this same species. Though the bumble bee pollinators visit more flowers per inflorescence on a rewarding orchid, the researchers found that addition of sucrose solution to flowers manages to significantly reduce the occurrence of pollinators removing and transporting pollinia. They conclude that rewardlessness enhances seed paternity.

Wong, B.B.M. & F.P. Schiestl. 2002. How an orchid harms its pollinator. *Proceedings of the Royal Society of London, Series B, Biological Sciences* 269(1500): 1529-1532.

This paper describes a recent experiment to examine any deleterious effects pollination of a deceptive orchid, Chiloglottis trapeziformis, may have on its pollinating wasp, Neozeleboria cryptoides. This orchid mimics female sex pheromones and appearance. Population biology of the wasp appears to be influenced by erroneous pollination, which reduces the number of copulations that males attempt with females. This is of course dependent upon the phenology of both species, and relative abundances of each, as well as the ability of males to learn to not make mistakes.