Why don't orchid pollinators go extinct? The persistence of the costly coevolutionary relationship between the sexually deceptive *Cryptostylis* orchids and their duped pollinator

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The sexually deceptive Australian and New Zealand *Cryptostylis* orchids are extreme deceivers: causing their wasp pollinator, *Lissopimpla excelsa* to ejaculate and waste limited sperm. Despite exerting great costs upon their pollinators, these orchids achieve outstanding pollination rates. Why, then, don't their pollinators go extinct?

We propose that costs are buffered by counter-adaptations, and a new concept, species-level 'resilience' traits. Field experiments at sites with (n=3) and without (n=3) natural populations of orchids in Sydney, Australia revealed evidence for counter-adaptations. We found evidence that male pollinators in sympatry with orchids spend less time mating with orchids; are less likely to waste sperm; and have more sperm and longer antennae than those that are not.

We produced a mathematical model to investigate the role of resilience traits. These traits allow a species to avoid extinction: reducing an individual's ability to escape exploitation via counter-adaptations whilst maintaining exploiter fitness. For sexual deception by *Cryptostylis* orchids, Haplodiploidy could act as a resilience trait. Unmated Haplodiploid pollinator females deprived of sperm by orchids can still produce offspring, albeit all sons. An overabundance of sons would further enhance orchid pollination rates and fitness, while providing enough males to maintain pollinator populations. Our model found that when exposed to the same costs, haplodiploid wasps (e.g *L. excelsa*) persist over evolutionary time while diploid wasps become extinct.