Communication and Marketing Department
Isebe loThungelwano neNtengiso
Kommunikasie en Bemarkingsdepartement

Private Bag X3, Rondebosch 7701, South Africa
Welgelegen House, Chapel Road Extension, Rosebank, Cape Town
Tel: +27 (0) 21 650 5427/5428/5674 Fax: +27 (0) 21 650 5628

www.uct.ac.za

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Orchid sexually exploits male beetles – a world first from Africa

Dr Callan Cohen, a research associate of the University of Cape Town's (UCT) FitzPatrick Institute of African Ornithology, has discovered a world pollination first: an orchid that sexually exploits longhorn beetles. The near-extinct *Disa forficaria*, known from a single remaining plant in the mountains near Cape Town, mimics a female beetle so convincingly that the male beetle mates with the flower, thus pollinating it.

Dr Cohen and a team of local and international researchers discovered an entirely new chemical system involved in this deception, and they are pioneering the process of using pollination to survey for the presence of critically endangered plants.

These discoveries stem from Cohen's search for rare African orchids in the mountain ranges near Cape Town. *Disa forficaria* – a relative of the iconic Red Disa – was last seen in 1966, and only 11 of these plants have been found in the last 200 years, making it one of the rarest plants in the world. In an attempt to document the last known plant, Cohen aimed to take detailed photographs of it.

Deceived beetles
"Incredibly, while I was observing, a beetle flew to the plant and clearly mated with it," he recalled.

Orchids are known as deceivers; they mainly utilise food deception, by imitating plants with nectar despite having none. They have been found to use sexual deception on bees and wasps. But while beetles are the oldest known pollinators of plants, and the most diverse group of plant pollinators, this was the first clear case of a plant sexually deceiving a beetle.

Proving sexual deception
Cohen assembled a joint South African and international team to investigate the phenomenon, including UCT alumnus and world-famous pollination researcher Professor Steven Johnson; Adam Shuttleworth; UCT's Centre for Statistics in Ecology, Environment and Conservation associate Dr Jonathan Colville; and orchid experts William Liltved and Benny Bytebier.

Noticing that the beetle had a small, penis-like organ which it inserted into the modified lip of the flower, Cohen took several macro photographs of the flower just before the moment he predicted the beetle would get to the flower. Once it had, he found that it left something

behind; the substance was tested, and conclusively showed sperm. "This is only the second time in the world that an insect has been found to ejaculate on a plant during pollination," said Cohen.

A new chemical system
Following this discovery, the researchers wanted to find out what chemical was attracting the beetle to the flower. They took a sample from the flower and caught a beetle to test in the laboratory. They found that the active chemical in the flower was what had attracted the beetle.

The team sent the plant extract to a top chemist in Germany, the Max Planck Institute's Dr Ales Svatos, who identified the chemical involved and whose colleague, Dr Jerrit Weissflog, synthesised possible forms of its molecular structure. The chemical was a previously undiscovered macrolide, which the team named 'disalactone'.

After testing the synthesised molecules in the field, the team found that the beetles all came to a particular form of the synthesised component, believed to be a mimic of the female beetle pheromone produced by the orchid.

A conservation world first
During their experiment with the synthesised molecules, they discovered that some of the beetles were carrying pollen (confirmed by genetic barcoding) from at least two other individuals of the *Disa*, proving the plant is not extinct.

The team realised that they could now survey for the flowers by using the synthesised chemical to attract beetles that might carry evidence of the real orchids. "This resulted in narrowing down the area where the rare plants exist, and allows for a concentrated search for the orchid. Using pollinators to see if an endangered plant is present in the area is also a world first," said Cohen. "This discovery can help save the critically rare orchid, on the edge of extinction, with a novel chemical survey technique."

Way forward
Following these multiple discoveries, and the recent publication of Cohen and the research team's findings in *Current Biology*, pollination experts from around the world are studying the consequences and implications.

The research findings of Cohen *et al*. also provide insights into long-horned beetle pheromones; the beetle's larvae burrow in wood and are thus important commercially.

Finally, the research provides further perspectives into the biological function of macrolides, which are important components of many antibiotics.

Written by Carla Bernardo, Katherine Wilson and Dr Callan Cohen, UCT News

This African orchid, "Disa forficaria", mimics a female beetle so convincingly that the male beetle mates with the flower, thus pollinating it. Photo: Callan Cohen

Near-extinct 'Disa forficaria' mimics the appearance and chemistry of a female beetle.

Photo: Callan Cohen

Beetles are attracted by a newly described chemical, and even ejaculate into a false cloaca on the orchid's lip. Photo: Callan Cohen

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Issued by: UCT Communication and Marketing Department

Aamirah Sonday

Media Liaison and Monitoring Officer

Communication and Marketing Department

University of Cape Town

Rondebosch

Tel: (021) 650 5427

Email: aamirah.sonday@uct.ac.za
Website: www.uct.ac.za