ABSTRACTS:

Chemical Mimicry:

Oral Presentations

In programme order

Session 7

Long-horny-beetles and single orchids: discovery of a new class of sexual mimicry in plants

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Sexual mimicry is a reproductive strategy used mainly by plants with flowers that imitate the mating partners of animals, in order to exploit them as pollinators. This form of deception is known mostly from orchids that exploit Hymenoptera or Diptera as pollinators. We recently discovered a case of floral sexual mimicry that involves the deception of male longhorn beetles (Cerambycidae). The Cape endemic orchid *Disa forficaria* is pollinated by males of a single species of beetle to which the flowers bear an uncanny resemblance. Male beetles show copulatory behavior on the flowers and microscopic examination of flowers showed that they ejaculate sperm onto the hairy tip of the floral lip. Using GC-EAD and mass spectrometry techniques we identified and then synthesized a single novel macrolide that is electrophysiologically active and highly attractive to male beetles in field bioassays. Structure-activity studies confirmed that chirality and other aspects of the structural geometry of the macrolide are critical for attraction of the male beetles. The orchid itself is extremely rare with only 11 individuals having been recorded in the past two centuries.

Keywords: Cerambycidae, chemical synthesis, GC-EAD, pheromone, pollination

Scent-mediated deceptive strategies in fly-pollinated *Aristolochia*

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Deceptive flowers trick pollinators into visiting them by advertising a reward, which they do not provide. Numerous deceptive plants are pollinated by Diptera and rely on floral scent for attracting these insects. Apart from sapromyiophilous pollination systems, the chemical ecology of such interactions remains largely unstudied. We worked on seven deceptive *Aristolochia* (Aristolochiaceae) species in the Mediterranean, which are mainly pollinated by the dipteran families Phoridae, Drosophilidae and Chloropidae. Their peculiarly shaped flowers temporarily trap their pollinators and release them loaded with pollen. To resolve the mechanisms of pollinator attraction and deceptive strategies, we identified pollinators and applied chemical-analytical methods, chemical synthesis, electroantennography, and behavioral assays. We show that pollinators are, as expected, attracted by floral scent, the composition of which being strongly different among the studied species. Scent blends mostly consist of only a small number of compounds, including widespread floral volatiles, but also compounds previously unknown from floral scents. The scents of the different *Aristolochia* species resemble fermenting fruits (acetoin and derivatives), alarm pheromones of bugs (aliphatic esters), carrion (sulfides and pyrazines), as well as possibly sex pheromones of Phoridae (known and novel aliphatic compounds). Attractiveness of synthetic mixtures of these scents to pollinators was tested in field bioassays. Our results suggest that the studied *Aristolochia* species exploit various deceptive strategies, including chemical mimicry of food-sources of kleptoparasitic flies, oviposition-sites (most likely invertebrate carrion), and possibly sexual deception.

Keywords: chemical mimicry; electroantennography; deceptive pollination; floral scent; fly pollination

Revolver flowers fool freeloaders – pollination strategies of trap and non-trap flowers in Stapeliinae (Apocynaceae)

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The Stapeliinae comprise outstanding floral diversity and complexity with multiple shifts from pitfall (*Ceropegia*) to non-pitfall (*Brachystelma*, stapeliads) flowers and emerging evidence of diverse chemical mimicry strategies. This diversity of form and strategies is, somewhat paradoxically, driven by a single, albeit functionally diverse pollinator group – flies. Understanding the evolution and diversification in Stapeliinae requires detailed understanding of both pollination ecology and mechanism (pollinator specificity), as well as identification of cues pollinators use to locate flowers. Thus far, studies have focussed on *Ceropegia* pitfall flowers where evidence exists that floral chemistry plays a key role in pollinator attraction and in achieving pollinator specificity. Many species are pollinated by Diptera with kleptoparasitic habits, i.e. they are freeloaders on prey of predatory arthropods. These flies locate such food sources using volatiles released by the prey when attacked or freshly killed. Some *Ceropegia* species chemically mimic injured insects to lure freeloader flies into their pitfall flowers and use them as non-rewarded pollinators. This remarkable strategy called kleptomyiophily seems widespread among *Ceropegia* though other strategies, i.e. yeast mimicry, have also been discovered. Recent studies on non-trapping *Brachystelma* species have revealed different strategies to *Ceropegia*, with some species mimicking carrion or dung and attracting different groups of fly pollinators. Intriguingly, however, some species also attract kleptoparasitic flies of the same genera as are attracted by *Ceropegia* species. Chemical and electrophysiological analyses suggest that the basis of initial attraction is similar to that in *Ceropegia*. The presence of rewards in *Brachystelma* seems to further promote successful pollination.

Keywords: chemical mimicry; deception; fly pollination; kleptomyiophily; strategy-shifts

Flies, flowers, and fermentation

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Pollination systems involving floral mimicry are fascinating study arenas with which to explore floral phenotype evolution, pollinator sensory perception and behavior, and the interaction of the two. In most cases, the flower's chemical mimicry of the model's volatile chemistry is a key component of the mimic's pollination success. Floral mimicry of fermenting substrates is not well-documented, yet an increasing number of studies identify fermentation-associated volatiles in floral scents. Furthermore, naturally-occurring fermenting substrates (fruit, sap, etc.) attract a diversity of flies, beetles, and other insects which could be utilized as dupes (pollinators) by a flower mimicking fermentation. We investigate floral mimicry in *Asimina triloba* (Annonaceae), a woody species with spring-blooming, maroon, yeasty-smelling flowers that are pollinated by fermentation-loving species of Diptera. While the unusual floral phenotype and associated insect taxa suggest that the flower is mimicking a non-floral fermenting substrate, we seek to demonstrate (1) the occurrence of an ecologically-relevant model upon which the mimic is based, and (2) that the visitor identity and behavior at the model overlaps with the visitor identity and behavior at the flowers. Here we present data documenting the overlap of floral phenotype with several ecologically-relevant models. We also present data on pollinating insects and insect visitors to local fermenting substrates.

Keywords: *Asimina triloba*; Diptera; floral mimicry; pollination; volatiles

ABSTRACTS:

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Poster Presentations

In programme order

Poster Session 1

Can colour pattern be a "magic" trait in transparent aposematic and mimetic butterflies?

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Despite being transparent to some degree, clearing butterflies are not entirely cryptic as they possess bold and colourful markings on their wings. They also engage in mimetic interactions with other unpalatable butterfly species, and as Müllerian mimicry is the result of convergent selection on a warning display, this suggests that the colour pattern in this system is both recognized and avoided by predators. Although wing colour pattern in aposematic butterflies is a trait that shows rapid evolution with a known role in reproductive isolation, it is unclear whether this is also true for transparent Ithomiini species. We set out to test factors that drive mating isolation, and therefore speciation, between two parapatric and ecologically similar taxa of the transparent *Ithomia salapia* found in north-eastern Peru. Our data shows nearly complete mating isolation, despite being the early stages of divergence. In stark contrast to non-transparent Ithomiini, recent divergence is accompanied with strong differentiation in pheromones. This may reflect a general need for further reproductive barriers fairly early in the speciation process as a result of the more inconspicuous nature of their colour pattern, but diversification may still be initiated by changes in colour pattern associated with changes in mimicry ring. That is not to say that this is true for all clearwing butterflies, as different evolutionary scenarios are possible and further studies are needed to shed further light on why some taxa are prone to diversify more than others and what circumstances are conducive for this.

Keywords: assortative mating; behaviour; divergent selection; pheromone; prey defenses