**Phenotyping - when it takes chemistry to work**

According to the scientific dictionaries, the concept of a phenotype covers the [morphology](https://en.wikipedia.org/wiki/Morphology_(biology)) or physical form and structure of an organism, its [developmental](https://en.wikipedia.org/wiki/Developmental_biology) processes, its biochemical and physiological properties, its [behaviour](https://en.wikipedia.org/wiki/Behavior), and the products of its behaviour. Yet, the importance of chemical phenotypes is often overlooked, despite chemical processes underpinning phenotypical differences on multiple levels, from structural properties, colour, smell and taste. In my lecture, I will demonstrate how chemical components in plants and insects not only hold the key to defining phenotypes, but how they can also define ecotypes and even species.

Insect pheromones, which by definition are the chemical compounds used for communication between conspecific individuals, offer classical examples of chemically mediated phenotypes. Among the biodiverse Australian thynnine wasps, sex pheromones are of paramount importance for wasp reproduction. I will discuss the identification processes related to the study system of the chemically diverse wasp sex pheromones. I will then show how these normally private communication channels have been intercepted by Australian orchids to achieve pollination by sexual deception.

Over 300 species of orchids worldwide are pollinated by sexual deception - with the help of the mimicry of pollinator sex pheromones. A hotspot for sexually deceptive orchids is in South-Western Australia. Apart from the generally intriguing pollination strategy, we have unveiled the truly fascinating chemistry used by these orchids, and the unsuspected variety of chemical signals involved, which likely is underpinned by complex biosynthetic machinery. I will discuss both the methodology we have used to make these discoveries, and also showcase the new-to-science semiochemicals found in hammer orchids, spider orchids, greenhood orchids and slipper orchids. Furthermore, I will show how compounds represent not only chemical phenotypes, but traits that can be used to define several of these orchid taxa as chemotypes, ecotypes, subspecies and even species.

While pollination by sexual deceit is an unusual, yet world-wide, highly specialised pollination strategy where it takes chemistry to work, plants with more generalised pollination systems, employing well-known pollinators such as honey bees, can also be defined by chemotypes, or chemical phenotypes. I will briefly discuss the role of nectar volatiles and floral volatiles in the pollination of carrot as a seed crop, showcasing that individual floral compounds can directly affect the attraction of honey bees to carrot nectar.

In summary, by drawing on examples from both highly specialised and highly generalised pollination systems, my lecture will highlight the critical importance of chemical investigations to understand plant-pollinator interactions. Looking forward, I advocate a more general inclusion of chemical considerations and investigations in phenotyping projects and plant-breeding programs.