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## Marie E. Herberstein, Dr. rer. nat.

Professor of Biological Sciences

Macquarie University, Sydney

Born in 1968 in Graz, Austria

Studied Biology at the University of Vienna

FOCUS

### PROJECT

## Global Patterns of Warning Colours - How Variable are They?

Many species of toxic prey advertise their distastefulness through conspicuous warning colours such as red and yellow dots or stripes. Naive predators quickly learn to associate warning colours with an unpleasant taste and avoid future encounters with such prey. Certain colours that contrast strongly against the natural background are commonly observed in warning signals: yellow, orange, and red in combination with darker colours, such as black and blue.

Theory predicts conspicuous and invariable warning signals, but surprising variation exists not only between populations and species but also within populations. The existence of such signal polymorphisms or less conspicuous warning signals in toxic prey is a puzzling and unresolved question in evolutionary biology.

In this project, I will investigate how warning colours in insects vary globally, across broad ecosystem regions. I propose to conduct a broad-scale review of warning colour patterns across global and climatic regions. I intend to utilise guidebooks and diversity databases to characterise warning signal colour and size in known aposematic insect groups.

The initial hypothesis I want to test is that warning colours have a greater proportion of black to yellow/orange/red in colder climates than in warmer climates. However, the power of this type of global analysis is in generating new hypotheses as to why warning signals vary.

### Recommended Reading

Heiling, A. M., M. E. Herberstein, and L. Chittka (2003). "Pollinator attraction: crab-spiders manipulate flower signals." *Nature* 421: 334.

Kemp, D. J., M. E. Herberstein, L. J. Fleishman, J. A. Endler, A. T. Bennett, A. G. Dyer, N. S. Hart, J. Marshall, and M. J. Whiting (2015). "An integrative framework for the appraisal of coloration in nature." *American Naturalist* 185: 705-724.

O'Hanlon, J. C., G. I. Holwell, and M. E. Herberstein (2014). "Pollinator deception in the orchid mantis." *American Naturalist* 183: 126-132.

# Warning signals and Mimicry - Predator Defense in Insects and Spiders

Predators are powerful agents of selection that target the shape, size, and smell of their prey. The evolutionary outcomes of this relentless predation pressure on prey are crypsis, bold warning colors, and deceptive mimicry. This process is not static, but dynamic - predator individuals that are able to detect, overcome, and see through disguises will have greater foraging success; and prey individuals that are even better at hiding, repelling, and deceiving will have greater survival rates. This dynamic plays out on long evolutionary scales (over millions of years) and every season on much smaller ecological scales.

Together with Johanna Mappes and David Kikuchi, I am trying to understand why prey that use warning colors or deceptive mimicry are so variable in shape and color - for example, some spider species mimic ants perfectly (thereby avoiding most predators that are averse to ants), while other are barely convincing, at least to the human eye. And why are warning signals within a species so variable - surely consistency in the message is important? Do predators even perceive this variation and does this variation matter to predators?

In this seminar, I will present some work that has led up to our Wiko project and describe the progress we have made since at the Wiko. Time permitting, we might even play an online game, where you can be the predator. I will also set aside some time to answer any questions related to spider biology you might have.

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## PUBLICATIONS FROM THE FELLOWS' LIBRARY

Herberstein, Marie E. (Chicago, Ill.,2022)

The effect of predator population dynamics on Batesian mimicry complexes

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1795570709>

Herberstein, Marie E. (Oxford,2021)

Why aren't warning signals everywhere? On the prevalence of aposematism and mimicry in communities

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1761909487>

Herberstein, Marie E. (Chicago, Ill.,2015)

An integrative framework for the appraisal of coloration in nature

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1668672561>

Herberstein, Marie E. (Chicago, Ill.,2014)

Pollinator deception in the orchid mantis

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1668781522>

Herberstein, Marie E. (Oxford,2006)

Flower symmetry preferences in honeybees and their crab spider predators

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1047227177>

Herberstein, Marie E. (London,2003)

Crab-spiders manipulate flower signals

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1668782375>

Herberstein, Marie E. (London,2003)

Pollinator attraction : crab-spiders manipulate flower signals

<https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1668673835>  
Wissenschaftskolleg zu Berlin