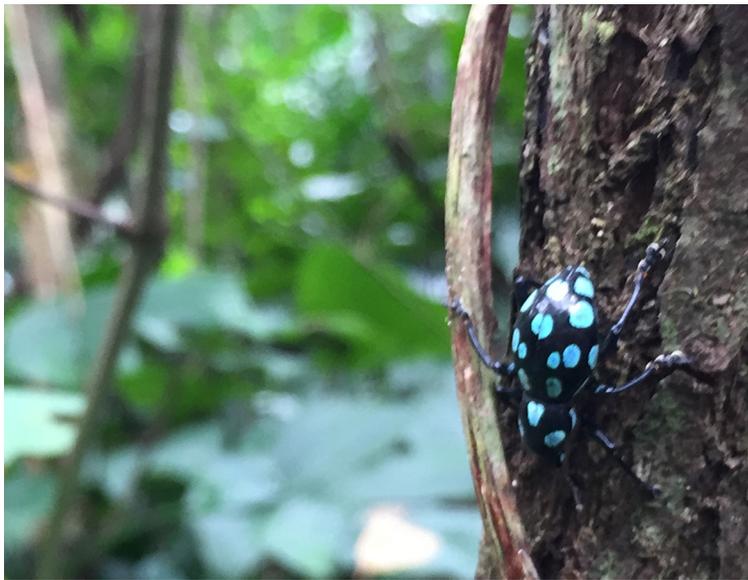


INSIDE JEB

Weevils too tough to chew for safety



A *Pachyrhynchus sarcitis kotoensis* weevil. Photo credit: Chung-Ping Lin.

Even before Alfred Russel Wallace became captivated by the exquisite colours of *Pachyrhynchus* weevils, the Tao people of Orchid Island knew that the tiny beetles were incredibly tough. ‘They have a legend saying that brave men with the power to crush the weevils with their own fingers are capable of bringing their beloved ones blissfulness’, chuckles Chung-Ping Lin from National Taiwan Normal University. Entranced by their vivid colours while travelling in Southeast Asia, Wallace suggested that the insects’ conspicuous markings may warn predators to avoid them, for fear of getting an unpleasant mouthful. ‘Aposematism [warning coloration] is established when the colour is associated with some effective secondary defensive strategy’, says Lin. However, no one had followed up on Wallace’s 150-year-old suggestion that *Pachyrhynchus*’ exquisite colouring may warn potential predators off and it

was still uncertain whether the weevils were warning predators that they simply taste awful, could irritate their attacker’s mouth or are just too hard to swallow.

Having visited the Orchard Island homes of the iridescent *Pachyrhynchus sarcitis kotoensis* weevil, Lin and his colleagues decided to find out precisely why predators avoid this particular member of the *Pachyrhynchus* family. ‘The problem was that we had to obtain young “soft” weevils too’, says Lin, which seemed impossible until Lin, Wen-San Huang and Lu-Yi Wang managed to collect six adult weevils from the luscious island vegetation. Lin also recalls that raising the young weevils was challenging. ‘The larvae only feed on the soft part inside their host plant, which is difficult to access from the North of Taiwan’, he says. However, the patience of Hsin-Chieh Tang and Lung-Chun Huang from the Taipei City Zoo was eventually

rewarded when soft young adult weevils emerged from their pupae.

Offering the week-old soft weevils and 2-month-old hard weevils to Taiwan japalure lizards (*Japalura swinhonis*), Lin filmed the lizards’ responses and was impressed when all of the hard weevils were spat out unharmed. ‘The lizards made no more predatory attempts after spitting out the weevils’, says Wang. However, the soft weevils were not so lucky; the lizards chewed on them enthusiastically. And when she removed the beetles’ foot claws, which may harm the lizards’ mouths, the predators were still unable to eat the hard weevils; sharp claws were no deterrent. However, it was still possible that the lizards were discouraged by the beetles’ flavour. After immersing the insects in ether, Wang analysed the molecules that had been washed from the weevils’ bodies, yet none turned out to be unpleasant-tasting toxins.

‘*Pachyrhynchus* weevils prevent attack from predators by their robust bodies while no other effective secondary defences, such as sharp claws or toxic chemicals, exist’, says Lin. In other words, being hard is a sufficient deterrent to keep the weevils safe and, once a japalure lizard has taken a nip at one of the gaudy insects, it should know better than to take another. Lin also suspects that Wallace would be delighted that his hypothesis is still inspiring 21st century scientists. ‘I think it would make him smile to know that people are still reading his writings after more than a century’ smiles Lin.

Wang, L.-Y., Huang, W.-S., Tang, H.-C., Huang, L.-C. and Lin, C.-P. (2018). Too hard to swallow: a secret secondary defence of an aposematic insect. *J. Exp. Biol.* **221**, doi:10.1242/jeb.172486.

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