Pebble-mimic dragons

Scientists are increasingly using molecular sequences to understand the complexity and evolutionary history of life on Earth. Advances in methods used to compare DNA between organisms can be used to explore the relationships between different phyla and the differences between species and the genetic make-up of individuals. What may have seemed like a pipedream a couple of decades ago, is now being routinely performed in laboratories around the world. Molecular tools can also be used forensically to establish links between larvae and adults of insects, or seeds and whole plants.

In 2008, researchers from Museum Victoria (Luke Shoo, Rebecca Rose, Jeremy Austin and Jane Melville) and the Western Australian Museum (Paul Doughty) published a research paper which used molecular sequence data to show that there were multiple different lineages of Australian pebble-mimic dragons (genus *Tympanocryptis*) in the Australian arid zone. And their differences weren't small ones. The genetic divergence between the various populations they studied suggested that they had been separate evolutionary lineages for more than two million years in most cases. But like many other scientific publications that study genetic divergences of the Australian biota, the researchers were unable to confirm that these lineages represented different, distinct species, or whether they were simply long-isolated populations of a single widespread species.

The only way to settle this was to head back to the museum collections and examine as many specimens as possible, including the specimens that had been used in the original molecular analysis, to see if there were any morphological characteristics that could be used to test the hypothesis that they were distinct species. Most models of speciation events – the process by which populations become reproductively isolated from each other – suggest that lack of gene flow occurs first, followed by morphological change. And while it is usual that different species have differing morphology, it's not always the case, especially in 'cryptic' species where molecular differences are large but there are no obvious morphological differences.

Seven years after the original publication on pebble-mimic dragons, some of the authors of the original paper (Paul Doughty, Luke Shoo and Jane Melville), plus a new researcher (Luke Kealley) joined forces to examine the morphology of the Western Australian specimens and compare them to the phylogenetic analysis. They found that while differences in colour and scale patterns were fairly subtle, there was sufficient morphological change for them to propose that there are five distinct species in the region.

One of them, *T. cephalus*, was described by Albert Günther in 1867 from specimens collected at Nickol Bay, Karratha. The second already had a name which had been regarded as a synonym of *T. cephalus* for several decades. The authors have resurrected the name *T. gigas* and applied it to the populations from the Gascoyne region. They didn't have access to any tissue samples of *T. gigas* for the molecular analysis but ascertained it was a distinct species based on the subtle colour and morphological differences compared to the other species. The other three represent new species, two from the Pilbara, and one widely distributed in the Goldfields. The widespread species is the one that's been figured in reptile textbooks as *T. cephalus*.

By any standard, this is an outstanding result – what was once thought to be a slightly variable complex of species has been proven to consist of five discrete species with non-overlapping (allopatric) distributions. This discovery highlights the value of using and interpreting molecular sequence data to uncover relationships between organisms, to test species concepts using a combination of molecular and morphological data. In fact, this study would not have been possible without the large collection of reptiles lodged in the WA Museum. Many of those used in the study were collected during the Pilbara Biodiversity Survey by Parks and Wildlife's predecessors and the WA Museum.

And finally, it shines a light onto a fascinating group of lizards, renowned for their ability to mimic a small rock by lying motionless even when closely approached. This cryptic behaviour has allowed them to avoid predation in some of Australia's harshest ecosystems.

Above A new species of *Tympanocryptis* from Matuwa (formerly Lorna Glen).
Photo – Ryan Ellis