Kangaroos chew over evolutionary theory

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Researchers Aidan Couzens and Gavin Prideaux examining the teeth of extinct kangaroos at the Palaeontology Laboratory at Flinders.

What if snakes could grow legs, or chickens develop teeth, or humans re-evolve tails like our primate ancestors?

According to new research led by Flinders University, reversible evolution is possible under certain conditions – even after many millions of years.

A new paper, published in the journal *Evolution*, casts new light on the long-held idea that once a structure or organ is lost during the course of evolution, it cannot be recovered in descendant species.

The Australian and UK team of scientists show that some of the largest kangaroos ever to evolve resurrected crests on their teeth that were present in their distant ancestors more than 20 million years earlier.

Changes in climate, habitat and diet are the reason. As forests retreated towards the coastline over millions of years, kangaroos were forced to eat more grass, with their teeth needing to cut rather than chomp away at their food, the researchers say.

As forests retreated, grasses and other abrasive plants became more abundant and kangaroos shifted their diets to exploit them, says Flinders School of Biological Sciences PhD candidate Aidan Couzens who used a simple mathematical rule to show that re-evolving these features may not be so difficult as previously thought.

"We show that small changes to a 'rule' that determines how teeth form in the embryo have allowed some kangaroos to partly turn back the clock on evolution," Aidan says.

"Using these rules, we can start to predict the pathways evolution can take.

"We found that contrary to Dollo's law in biology, features lost in evolution can re-evolve when evolution 'tinkers' with the way features are assembled in the embryo."

Biologists have often discounted the potential for evolution to shift into reverse, dismissing such occurrences as convergent evolution, "where similar features evolve independently in organisms that are not closely related," explains co-author Flinders Associate Professor Gavin Prideaux.

The researchers argue that "reanimating genetically mothballed features may be 'allowed' by evolution when it aligns with pressures that determine an animal's ecology".

The re-emergence of these molar traits was driven by changes in climate, habitat and diet.

Kangaroos and wallabies have been studied as barometers of historical climatic change in Australia, Associate Professor Prideaux says. "They have been around for at least 30 million years, and we are discovering more about how early forms were adapted to the abundant soft-leaved forest plants and how later macropods adapted to more arid conditions," he says.

The latest research findings resulted from collaboration between scientists at Flinders University and the Max Planck Institute for Evolutionary Anthropology in Germany, University of Kent in England, Monash University and Museum Victoria.

More information: Aidan M. C. Couzens et al. The role of inhibitory dynamics in the loss and reemergence of macropodoid tooth traits, *Evolution* (2016). DOI: 10.1111/evo.12866

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