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Breeding biology of giant Australian thunderbirds paves way to extinction

Big bones from the extinct 'thunder bird' or dromornithid indicate that while their size and breeding cycle gradually changed over millennia, they ultimately could not keep pace with the environmental changes around them.

The specimens were excavated in the northern Flinders Ranges (mountain range) and near Alice Springs in Australia. Bone microstructure studies on the fossil bones were conducted by University of Cape Town (UCT) and Flinders University vertebrate palaeontologists.

The research, published in *The Anatomical Record*, compares the bones of the oldest and largest mihirung, *Dromornis stirtoni,* which lived seven million years ago, stood up to three metres tall and, had a mass of up to 600 kg, to the smallest of the flightless birds, *Genyornis newtoni* (the last species of mihirung) – which lived alongside early emus – historically the world's third-largest bird.

"Sadly for these amazing animals, which already faced rising challenges of climate change as the interior of Australia became hotter and drier, their breeding biology and size couldn't match the more rapid breeding cycle of modern day (smaller) emus to keep pace with more demanding conditions," said Professor Anusuya Chinsamy-Turan, from UCT.

Questions, such as how long these gigantic birds took to reach adult size and sexual maturity, are key to understanding their evolutionary success and their ultimate failure to survive alongside humans.

"We studied thin sections of the fossilised bones of these thunder birds under the microscope so that we could identify the biological signals recorded within. The microscopic structure of their bones gives us information about how long they took to reach adult size, when they reached sexual maturity, and we can even tell when the females were ovulating," added Chinsamy-Turan.

The study indicates *Dromornis stirtoni* – likely, the largest bird ever to live on Earth – took a long time to grow to full body size and to become sexually mature, possibly up to 15 years.

By the late Pleistocene era of *Genyornis newtoni* the climate was much drier with more seasonal variation and unpredictable droughts. These birds were six times larger than emus with a body mass around 240 kg but grew to adult size faster than the first mihirung – likely

within one to two years and started breeding soon thereafter. However, they needed several more years to reach adult body size and thus, their growth strategy is still quite slow compared to nearly all modern birds that reach adult size in a year and can breed in the second year of their life.

Co-author, Associate Professor Trevor Worthy from Flinders Palaeontology shared that dromornithids were contemporary with emus for a very long time before the final mihirung went extinct.

"In fact, they persisted together through several major environmental and climatic perturbations," he said. "However, while *Genyornis* was better adapted than its ancestors, and survived through two million years of the Pleistocene when arid and drought conditions were the norm, it was still a slow-growing and slow-breeding bird compared to the emu.

"The differing breeding strategies displayed by emus and dromornithids gave the emu a key advantage when the paths of these birds crossed with humans about 50 thousand years ago, with dromornithids going extinct about 40 thousand years ago.

"In the end, the mihirungs lost the evolutionary race, and an entire order of birds was lost from Australia, and the world."

Although the bones of the late Pleistocene dromornithids show their reproductive biology had responded to ever-changing climate pressures and that they were breeding sooner than their ancestors did, the strategy did not approach the reproductive efficiency shown by large ratite birds today.

For example, emus grow to full adult size and breed within one to two years. This type of breeding strategy allows their populations to rebound when favourable conditions return after periods of drought or food shortages which could cause population declines.

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