Medical imaging helps define Moa diet

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Painting of a mummified moa head with the reconstructed muscles painted in in colours around the base of the jaws and behind the eye. Credit: Peter Johnston

Medical scanners and the same software used to assess building strength after the Canterbury earthquakes, have revealed new information about the diet and dining preferences of New Zealand's extinct moa.

Researchers from Canterbury Museum, the University of Auckland, Finders University and the Universities of New England (Australia) and New South Wales have discovered that the nine species of moa were able to co-exist because differences in the structure and strength of each species' skull and bills were influenced by, or dictated by, diet.

The findings are published today in the journal *Proceedings of the Royal Society*, in London.

Co-author, Dr Peter Johnston from the University of Auckland's Anatomy and Medical Imaging department, made MRI scans of the mummified moa remains to allow accurate models to be made for the research.

The moa, which roamed New Zealand until the 15th century, were herbivores and some of the largest birds to have ever existed. The largest species, the South Island Giant moa, weighed up to 240 kg whilst the smallest (the upland moa) was the size of a sheep.

Until now scientists had thought that the huge difference in size between the species determined their foraging behaviour as well as what, when and where they ate (ie their ecological niche).

Co-author Professor Paul Scofield from Canterbury Museum says that the team took the most complete skulls of each species of moa from the collections of Canterbury Museum and Te Papa Tongarewa and scanned those using medical CT (Computed Tomography) scanners.

"We then produced highly accurate 3D models of each. This wasn't a simple job as we didn't have a single skull that was perfect so we used sophisticated digital cloning techniques to digitally reconstruct accurate osteological models for each species," Professor Scofield said.

Using the medical MRI scans of the mummified remains, Dr Johnston digitally reconstructed the muscles of each species.

"Each moa species has a characteristic bill shape and the reasons for this have not previously been defined," says Dr Johnston. "Charles Darwin had an easier time investigating a similar situation in Galapagos finches, as the differences are more extreme and the diets are obvious in that group of birds."

Software used by civil engineers after the Canterbury Earthquakes to identify weak or unsound buildings, was used to test the strength and structure of each moa species' bill.

These were compared to each other and to two living relatives, the emu and cassowary. The models simulated the response of the skull to different biting and feeding behaviours including clipping twigs and pulling, twisting or bowing head motions to remove foliage.

The skull mechanics of moa were found to be surprisingly diverse. The little bush moa had a relatively short, sharp-edged bill and was superior among moa at cutting twigs and branches, supporting the proposition that they primarily fed on fibrous material from trees and shrubs.

At the opposite extreme, the coastal moa had a relatively weak skull compared to all other species which may have forced them to travel further than other moa in search of suitable food, such as soft fruit and leaves.

Dr Trevor Worthy (a New Zealander working at Flinders University in

Australia) says "until now we have been limited in assessing anatomical function to examining the external aspect of bones. This new technology allows us to bring new life to old bones and to get one step closer to understanding the birds they came from."

"Little has been known about how New Zealand's ecosystem evolved, largely because we know so little about how moa lived and co-existed," says Associate Professor Stephen Wroe, leader of the Function, Evolution and Anatomy Research (FEAR) laboratory at the University of New England (Australia).

"This new research advances our understanding about the feeding behaviours of the moa species and their impact on New Zealand's unique and distinctive flora."

Provided by University of Auckland

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