Dinosaur wind tunnel test provides new insight into the evolution of bird flight (w/ Video)

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This is *Microraptor* in flight. Credit: Emily Willoughby

A study into the aerodynamic performance of feathered dinosaurs, by scientists from the University of Southampton, has provided new insight into the evolution of bird flight.

In recent years, new fossil discoveries have changed our view of the early evolution of birds and, more critically, their powers of flight. We now know about a number of small-bodied dinosaurs that had feathers on their wings as well as on their legs and tails: completely unique in the fossil record.

However, even in light of new fossil discoveries, there has been a huge debate about how these dinosaurs were able to fly.

Scientists from the University of Southampton hope to have ended this debate by examining the flight performance of one feathered dinosaur pivotal to this debate—the early Cretaceous five-winged paravian *Microraptor*. The first theropod described with feathers on its arms, legs and tail (five potential lifting surfaces), *Microraptor* implies that forelimb-dominated bird flight passed through a four-wing ('tetrapteryx') phase and represents an important stage in the evolution of gliding and flapping.

The Southampton researchers performed a series of wind tunnel experiments and flight simulations on a full-scale, anatomically accurate model of *Microraptor*.

Results of the team's wind tunnel tests show that *Microraptor* would have been most stable gliding when generating large amounts of lift with its wings. Flight simulations demonstrate that this behaviour had advantages since this high lift coefficient allows for slow glides, which can be achieved with less height loss. For gliding down from low elevations, such as trees, this slow, and aerodynamically less efficient flight was the gliding strategy that results in minimal height loss and longest glide distance.

Much debate, centred on the position and orientation of *Microraptor*'s legs and wing shape turns out to be irrelevant – tests show that changes in these variables make little difference to the dinosaur's flight.

Dr Gareth Dyke, Senior Lecturer in Vertebrate Palaeontology at the University of Southampton and co-author of the study, says: "Significant to the evolution of flight, we show that *Microraptor* did not require a sophisticated, 'modern' wing morphology to undertake effective glides, as the high-lift coefficient regime is less dependent upon detail of wing morphology."

This image shows Dr. Roeland de Kat (left) with Dr. Gareth Dyke. Credit: University of Southampton

"This is consistent with the fossil record, and also with the hypothesis that symmetric 'flight' feathers first evolved in dinosaurs for non-aerodynamic functions, later being adapted to form aerodynamically capable surfaces."

Dr Roeland de Kat, Research Fellow in the Aerodynamics and Flight Mechanics Research Group at the University of Southampton and co-author of the study, says: "What interests me is that aerodynamic efficiency is not the dominant factor in determining *Microraptor*'s glide efficiency. However, it needs a combination of a high lift coefficient and aerodynamic efficiency to perform at its best."

The paper 'Aerodynamic performance of the feathered dinosaur *Microraptor* and the evolution of feathered flight' is published in the latest issue of *Nature Communications*.

Dr Dyke and fellow Southampton palaeontologists will showcase their ground-breaking research at the Celebrating Dinosaur Island: Jehol-Wealden International Conference on 21 and 22 September.

Provided by University of Southampton