3D X-rays piece together the evolution of flight from fossils

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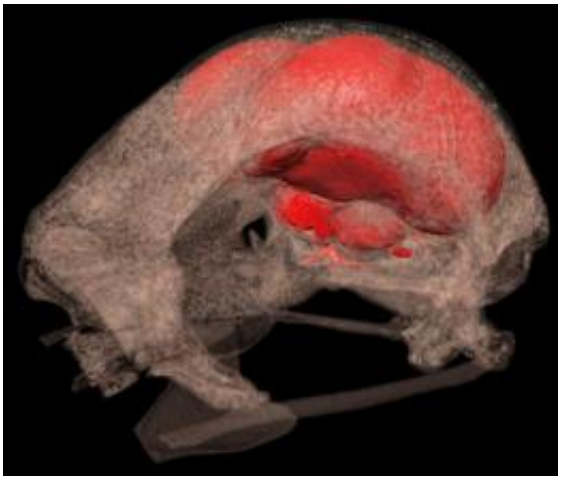
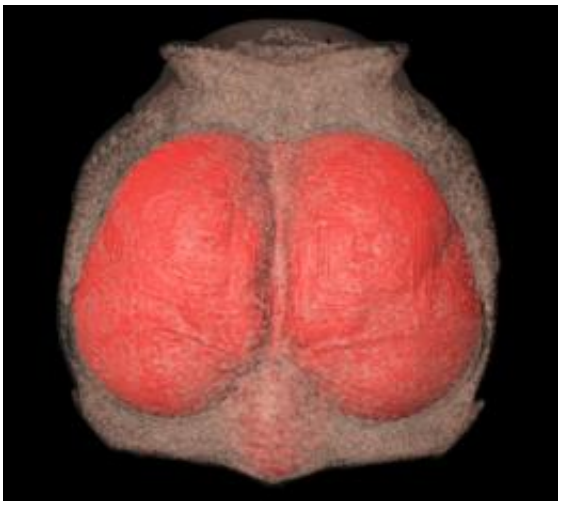


(PhysOrg.com) -- In a collaborative project between National Museums Scotland and the University of Abertay Dundee, researchers are using an incredibly sensitive CT (computerised tomography) scanner to analyse whole skulls and fossilised fragments and recreate accurate 3D models of extinct birds' brains.

Bird skulls grow to a fixed size before they leave the nest, with the brain then growing to almost completely fill the cavity space. This means that bird skulls can be used to accurately calculate the size and shape of the brain.

By working this out, the size of part of the brain called the flocculus can be established. This small part of the cerebellum is responsible for integrating visual and balance signals during flight, allowing birds to focus on objects moving in three dimensions while they are flying.

Dr. Stig Walsh, project leader and Senior Curator of Vertebrate Palaeobiology at National Museums Scotland, said: “By charting the relative size of parts of the avian brain we believe we can discover how the flocculus has evolved to deal with different flying abilities, giving us new information about when birds first evolved the power of flight.”



The central research question is whether a larger flocculus is directly linked to a greater ability to process the visual and balance signals during flight. If proven, this could mark a major step forward in understanding bird evolution, and may shed light on whether some remarkably bird-like dinosaurs were truly dinosaurs or actually secondarily flightless birds.

He added: “This research has only been recently made possible through advances in X-ray micro-CT scanning. Unlike medical scanners, which take a series of slice images through an object that may be up to 1.5 millimetres apart, the 3D scanner at Abertay University can be accurate up to 6 microns.

“By using such powerful equipment and around 100 different modern species we’re beginning to understand much, much more about the evolution of flight.”

The project is also looking at some of the rarest fossils in the world – including the only two skulls of a flightless sea bird from the Cretaceous Period around 100 million years ago.

What makes the fossils so rare is they were preserved in three dimensions in soft clay, not flattened by the pressure of earth above them like most bird fossils.

Patsy Dello Sterpaio, joint project researcher at Abertay University, said: “This is a hugely exciting project, which benefits greatly from Abertay’s high-powered micro-CT scanner. We hope that this joint project can produce not only incredible images, but also helps answer some of these important unresolved questions about the evolution of flight.”

Dr. Wilfred Otten, leader of the X-ray CT scanning facility at Abertay University, added: “The CT facilities at Abertay University are part of the SIMBIOS Centre for understanding complex ecological and environmental issues, which has an impressive team of experienced and successful experimentalists and modellers supporting its activities.

“Building from our expertise in environmental and soil science, we’re able to offer unrivalled expertise in capturing and quantifying interior

structures of a wide range of materials."

The computer analysis digitally reconstructs the shape and size of the skull, and creates a 3D 'virtual' brain model from the cavity inside the skull that housed the brain in life.

The project is also looking at flightless birds such as the dodo, to see whether the flocculus has become smaller with the loss of flight. The researchers believe that the brain power required for flight may have become reduced in such species.

The project is scheduled to run until early 2012.

Provided by University of Abertay Dundee