In search of the original flapper... new theory on evolution of flight

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(PhysOrg.com) -- A Manchester scientist has put forward a controversial new way of tackling a typically Darwinian chicken and egg question - the evolution of flapping flight in birds.

Dr Robert Nudds and Dr Gareth Dyke point to the obvious but hitherto overlooked fact that modern birds don't offer many clues about how they arrived at their current state of aerial prowess. The key to understanding how flapping flight arose, they claim, is not how proto-birds moved their limbs in a bird-like way, but rather how they came to move both forelimbs together in the first place.

"Birds are poor models of their flightless ancestors, the theropod dinosaurs," Dr Nudds, of the University of Manchester, explains. "They are at an advanced morphological stage in the development of flapping flight and possess uniquely avian musculature." So instead of trying to unravel the puzzle from the top down, the two collaborators took the alternative bottom up approach by winding the clock back 140 million years.

In search of the original "flapper" Drs Nudds and Dyke studied three feathered Jurassic dinosaurs, Caudipteryx and Protoarchaeopteryx, and the famous Archaeopteryx. They reasoned that the body forms of these animals must have overlapped that of the first dinosaur to evolve flapping flight, and used physical laws to calculate how much downward thrust each could have generated with its forelimbs, allowing them to estimate the type of morphology required for lift off.

Earlier studies carried out in the US looked at how flapping flight could have evolved, by making Chukar partidges run up an incline. Noting how wingbeats assisted the birds, the researchers claimed that such a process could eventually lead to the bird becoming airborne. However, most bipedal animals swing their forelimbs asymetrically, a movement that assists walking and running by twisting the upper body. Flapping flight requires symmetrical forelimb movement, not something that helps when running uphill.

Dr Nudds and Dr Dyke, of University College Dublin, say that understanding why bird ancestors began moving their forelimbs together is crucial to solving the riddle. One possibility is that a tree-dwelling lifestyle might have provided the necessary body form.

"If they were tree dwellers they would naturally hold their forelimbs out symmetrically, as they jumped from branch to branch or from ground to branch," Dr Nudds says. "However, if they were ground dwellers, which fossil studies suggest is more likely, holding the forelimbs out symmetrically would impede progress while running or moving along the ground. So there must have been another reason for this posture to appear."

Once this unique style of motion had evolved, the new findings suggest that the evolution of flight was a relatively straightforward process, as Dr Dyke explains: "Only certain combinations of wing movement and forward speed are effective in producing the thrust required to propel an animal into the air, but our calculations indicate that even moderate wing movements are enough."

This implies that flapping flight could have been the consequence of a series of gradual changes in wing shape and movement, and did not require a harder to explain large-scale shift.

Similarly, feathers need not have evolved for the purpose of flight. As modified scales, they might have provided insulation. Alternatively, says Dr Nudds, the mating game might have been influential. "Feathered forelimbs may have been used in a display ritual."

The study, which is published in the journal *Evolution*, demonstrates the role that fossils can play in understanding modern living organisms.

"I enjoy paleontological studies because of the scope for more imaginative thought than in other biological disciplines," Dr Nudds says. "It is like recreating a picture of the past, only with many of the jigsaw pieces missing."

"I'm looking forward to the next stage of our research - using computer models to simulate how the animals would have moved or building tiny mechanical models to look at the cost and benefits of each forelimb position. There's still plenty to look at and discover, so watch this space."

More information: The paper is available at www3.interscience.wiley.com/jo … l/121638147/abstract

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