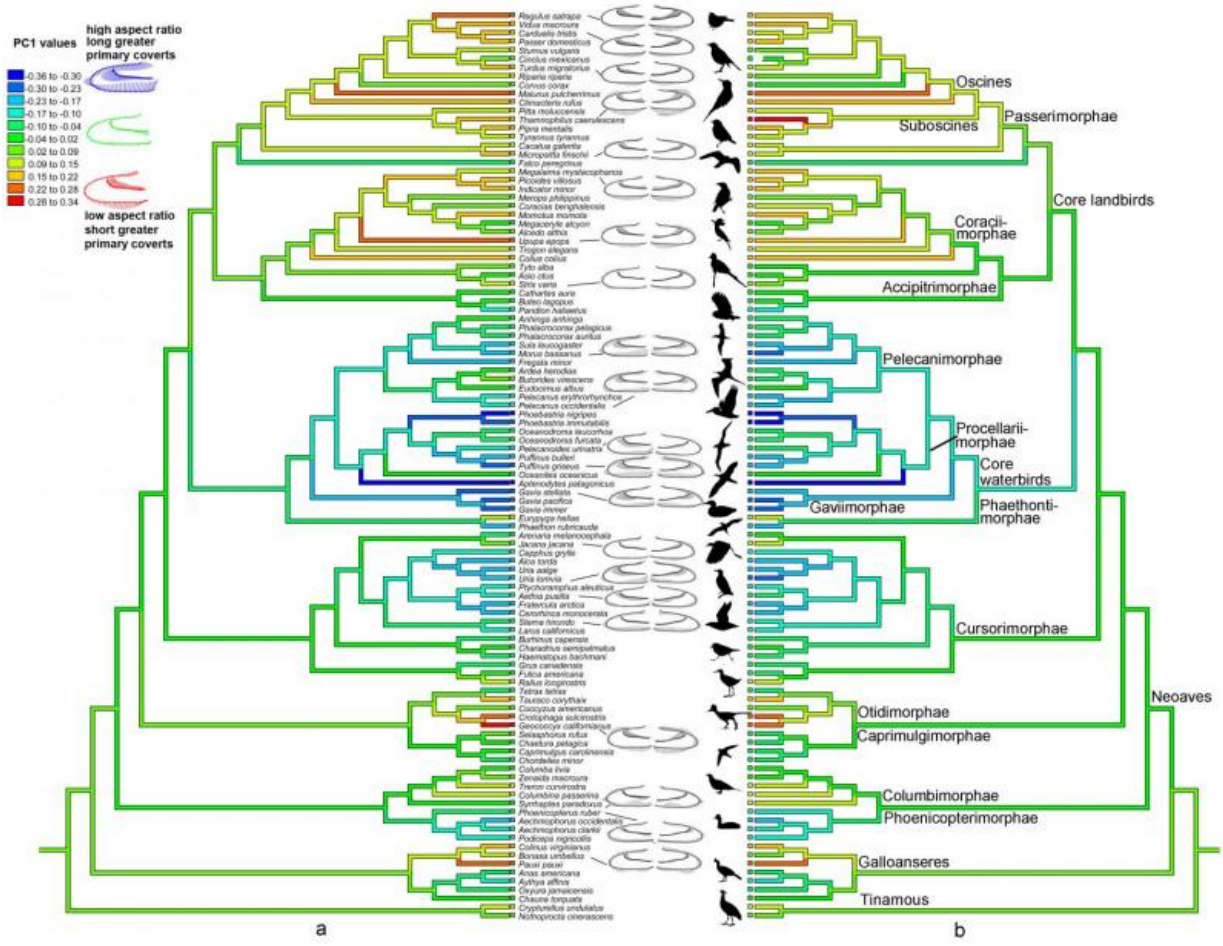
Shape of bird wings depends on ancestors more than flight style

November 5 2015



A cladogram depicting relationships between bird species and wing shape. Credit: Xia Wang.

In a finding that could change the way scientists think about bird evolution, researchers have found that the shape of bird wings is influenced more by how closely related species are to one another than by flight style.

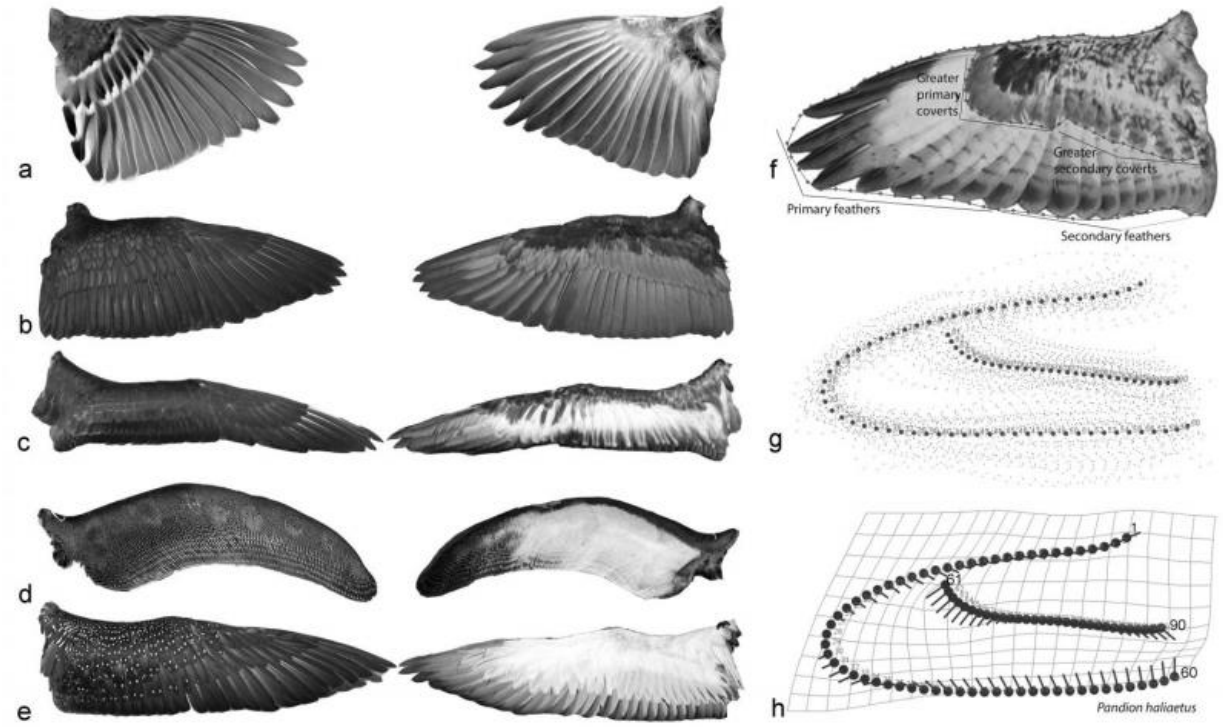
The research challenges scientific beliefs that assume the way a bird species flies—whether it primarily dives, glides or flaps, for instance—plays the primary role in the evolution of its wing shape. It also indicates that it may be more difficult than previously thought to infer flying behaviors of early birds and the first flying dinosaurs from fossils alone.

Julia Clarke, an associate professor in the Department of Geological Sciences at The University of Texas Jackson School of Geosciences, conducted the work with Xia Wang, a post-doctoral researcher who led the study. Their research was published in the journal *Proceedings of the Royal Society B: Biological Sciences* in October.

Bird wings, unlike stiff airplane wings, are flexible and change shape during flight. So, their geometry and wing outline may not tell the whole story of a particular flight style or environment, Clarke said.

"We've taken a lot for granted. Birds are not airplanes," Clarke said.

By comparing geometry across species and clades - groups of organisms that evolved from a common ancestor - the researchers found that birds that are closely related evolutionarily have similar wing structures, even if the birds show very different flight styles. For example, albatrosses, penguins and loons, despite looking very different from one another, all belong to the clade Aequornithes and have a wing shape that is very similar.



Samples of the dorsal (middle column) and ventral (left column) sides of wings from bird specimens analyzed by the researchers. The right column depicts a consensus wing shape generated by analyzing the wing shape of 105 bird taxon (figure f), a figure depicting how various wing shapes differed from the consensus wing (figure g), and the magnitude of variation across different parts of the consensus wing (figure h). Credit: Xia Wang.

The study is the first to analyze wing geometry across all major groups of birds. Researchers analyzed over 100 photographs of wings from different bird species.

In general, the analysis of species from across nine major avian clades showed that wing shape became more varied as different clades diverged from early ancestors, Clarke said. The researchers found an interesting exception to this trend in the wings of Passerines —a clade that includes songbirds. Instead of a wing shape that resembles more closely related

relatives, their shape resembles that of Galliformes, a distantly related order that includes birds, such as chickens and turkeys, whose direct ancestors were among the first birds on the planet.

"Those little songbirds share aspects of wing geometry, especially the relative length of the covert feathers, with some of early bird species but have very different body sizes, ecologies and flight styles," Clarke said.

Xia Wang, a post-doctoral researcher in the Department of Geological Sciences, with bird's wing. Credit: Xia Wang

Clarke and Wang also studied covert feathers in these birds. They found that across clades these feathers, which cover the base of the flight feathers, are about the same length whether they are on the top or underside of a wing. The similarity of covert feathers both on a single wing and across clades, brings into question their function, Clarke said.

It's been proposed that some of the upper coverts may play a sensory role, and the lower or underwing coverts, a role in aerodynamics. But the similarity in the distribution and organization of covert feathers on both sides of the wings suggests that such distinct roles may not be the case, Clarke said.

"There's no existing hypothesis to explain that pattern," Clarke said. "So a question now is why the length of these feathers tends to be similar and why they show similar trends across birds. We could be looking for a developmental explanation or a functional one."

More information: Xia Wang et al. The evolution of avian wing shape and previously unrecognized trends in covert feathering, *Proceedings of the Royal Society B: Biological Sciences* (2015). DOI: 10.1098/rspb.2015.1935

Provided by University of Texas at Austin