

## Fossil evidence sheds light on sexual selection during the early evolution of birds

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The impact of sexual selection on the evolution of birds has been widely acknowledged. Although sexual selection has been hypothesized as a driving force in the occurrences of numerous morphological features across theropod evolution, this hypothesis has yet to be comprehensively tested due to challenges in identifying the sex of fossils and by the limited sample size.

*Confuciusornis sanctus*, arguably the best-known early avialan, is represented by thousands of well-preserved specimens from the Early Cretaceous Jehol lagerstätte. So, it provides an opportunity to study the impact of sexual selection in extinct vertebrates. Among the fossil specimens, some exhibit characteristic elongated paired rectrices, while others do not. Previous studies suggested that the characteristic elongated paired rectrices could be a characteristic exclusive to males. Building on the largest sample size of *C. sanctus* to date, we conducted morphological studies.

The results revealed that the elongated paired rectrices in *C. sanctus* represents a sexual dimorphic trait. Statistical analyses further demonstrated sexual dimorphism in body size, relative skeletal lengths and allometry pattern (Figures 1 and 2). Males of *C. sanctus* exhibited larger body size compared to females (Figure 1). Additionally, the relative lengths of hind limb and major metacarpal in males were longer compared to females, it was due to faster growth rate of hind limb in males (Figure 2). We proposed that the longer hind limbs in males may compensate for aerodynamic costs caused by elongated paired rectrices. A similar phenomenon in extant birds with elongated tails is that longer wings are often seen in males. Furthermore, this study suggests that the male individuals with larger body size and longer hind limbs likely had greater reproductive success.

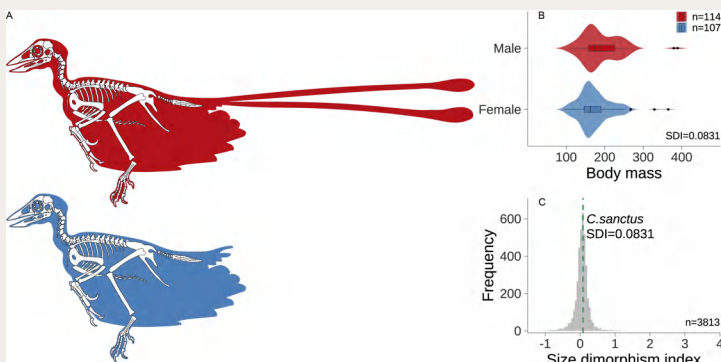


Figure 1. Sexual size dimorphism in *C. sanctus*.

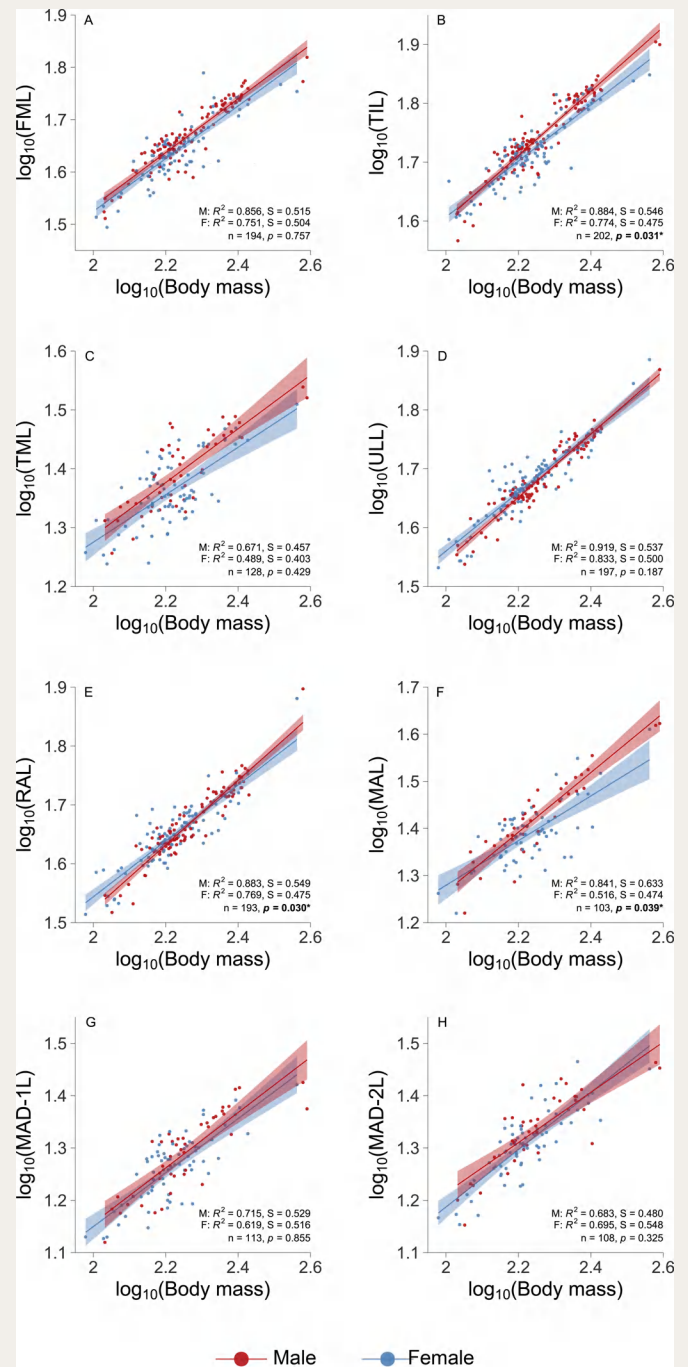


Figure 2. Sexual dimorphism in allometric growth pattern.

These results represent the earliest known sexual dimorphism in the evolution of basal birds. Such research highlights the joint role of natural and sexual selection in the evolution of body size and relative limb lengths during the early evolution of birds, deepening our understanding of the role of sexual selection in the macroevolution from non-avian dinosaurs to basal birds.

### Reference

Zhou, Y., Pan, Y., Wang, M., Wang, X., Zheng, X., & Zhou, Z. 2024. Fossil evidence sheds light on sexual selection during the early evolution of birds. *Proceedings of the National Academy of Sciences*. <https://doi.org/10.1073/pnas.2309825120>