Using past archives to constrain baselines in avian biodiversity

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Eligibility: Applicants that qualify for Home fee status are eligible and will have their tuition fees covered

Deadline for application: 23rd January 2023

How to apply: Application through UCL graduate school portal

Start date: No later than the 1st October 2023

Although birds number ~11,000 species today, 40% are in population decline, with 20% of species identified as at risk of extinction. Broadly, it is expected that ongoing climatic and environmental changes will result in a loss of avian biodiversity and a polewards shift in their geographic distributions, with large-bodied species thought to be at greatest risk of extinction. However, such forecasts are based entirely on very recent records. Even data from the last 500 years show that the present day represents a heavily filtered avian registry, with the extinction of >160 bird species in that time, including iconic forms such as the dodo and passenger pigeon. Current distributional ranges therefore likely reflect substantial anthropogenic disturbances, limiting the applicability of present-day data for forecasting. As such, our concepts of baselines of avian biodiversity, including extinction rate and selectivity, are severely distorted by the narrow temporal lens through which they are viewed.

The emerging field of conservation palaeobiology utilizes the fossil record to provide the only empirical data on long-term interactions between biodiversity, climate, and human impacts. This rich archive preserves information on past avian geographic distributions and climates different from those in the present day, including time intervals characterised by climatic conditions potentially analogous to near-future scenarios. Perhaps most importantly, it enables us to decouple the distorting effects of human influence on biodiversity, providing our only evidence of 'normal' extinction rate dynamics.

The disappearance of vertebrate species in many regions over the last 50,000 years is coincident with the arrival and modelled population growth of prehistoric modern humans. Many of the species that went extinct over this interval (including birds) were the largest members of their respective families, but it remains unclear whether size selectivity has been a consistent factor structuring avian extinctions prior to human influence, or if this pattern is primarily attributable to human-driven extinctions, as appears to be the case for

mammals. Were long-term climatic fluctuations the main driver of avian extinction patterns prior to human impacts? How much avian ecomorphological diversity have we already lost?

Using and contributing to The Paleobiology Database, this project will harness the rich fossil and zooarchaeological record of birds to understand how past avian extinctions were affected by long-term climatic changes over the last few million years (Plio-Pleistocene), and, more recently, by prehistoric human impacts. The PhD student will produce the first sampling-standardized regional baselines for avian biodiversity estimates prior to human impacts and before globalisation. Combined with collecting ecomorphological data (e.g. body size proxies) from avian fossils, this will enable the identification of unevenness in past extinctions across different taxonomic groups, ecomorphological categories, and geographical regions. The PhD student will also quantify how much ecomorphological diversity has been lost during this time interval.

This project will produce results that have implications for the past, present, and future of avian biodiversity. It will also dovetail with the recently developed IUCN Green Status of Species, which incorporates longer-term species trajectories to measure recovery against historical baselines.

The ideal candidate will have a good degree in the biological, ecological, or geological sciences. Although not a prerequisite, experience with programming and statistical languages, such as R or Python, is desirable. During the course of this project, the PhD student will receive training in: the collection and management of data from fossils, published literature, and archives; vertebrate anatomy and systematics; programming, statistical analysis, and diversity reconstruction; and the oral and written presentation of scientific results. There will also be the possibility of developing a taxonomic/anatomical side project. The student will also join a thriving community of palaeobiologists at University College London, as well as a wider London network (including the Natural History Museum and the Zoological Society of London), working on a wide variety of subjects, including the evolutionary history of dinosaurs, crocodiles, and mammals, as well as conservation palaeobiology projects.

Further reading:

Ali *et al*. 2022. Bird extinctions threaten to cause disproportionate reductions of functional diversity and uniqueness. *Functional Ecology* (DOI: 10.1111/1365-2435.14201).

Andermann *et al*. 2020. The past and future human impact on mammalian diversity. *Science Advances* 6: eabb2313 (DOI: 10.1126/sciadv.abb2313).

Joos *et al*. 2022. Quaternary megafauna extinctions altered body size distribution in tortoises. *Proceedings of the Royal Society B* 289: 20221947 (DOI: 10.1098/rspb.2022.1947).

Sayol *et al*. 2020. Anthropogenic extinctions conceal widespread evolution of flightlessness in birds. *Science Advances* 6: eabb6095 (DOI: 10.1126/sciadv.abb6095).

Smith *et al*. 2018. Body size downgrading of mammals over the late Quaternary. *Science* 360: 310–313 (DOI: 10.1126/science.aao5987).