GENES *as windows into the past*

Each bird species is uniquely adapted to a particular 'niche' – the combination of environmental features that are necessary for its successful reproduction and long-term survival. The species' present-day distribution is generally restricted to areas that satisfy these niche requirements. One of the most important influences on a bird's distribution is climate, because it affects both habitat structure and bird physiology. If climate changes over time, so too will the species' distribution.

During the Plio-Pleistocene (2.0 to 0.8 million years ago), the climate of southern Africa fluctuated dramatically between dry and wet periods, in tandem with glacial and interglacial climate cycles. During wet periods, the Karoo shrubland and Kalahari savanna of the arid western half of southern Africa contracted as forest, woodland and grassland habitats expanded into the west and south. When the climate cycle switched to a dry phase, the arid shrubland and savanna once again expanded eastwards and northwards.

Changes in population size and connectedness leave distinct genetic footprints on the genome (DNA) of a species in different parts of its range

During these climate fluctuations, the distributions and population sizes of bird species expanded or contracted, depending on whether their ecological niche was associated with wetter or drier conditions. A contracting population generally becomes less abundant and fragments into several isolated groups, whereas an expanding population becomes more abundant and previously isolated populations often merge. These changes in population size and connectedness leave distinct genetic footprints on the genome (DNA) of a species in different parts of its range.

TIM JACKSON

Initial molecular analyses suggest that the Brown Scrub-Robin as we recognise it today may comprise more than one species.

Since the early 1990s, evolutionary biologists have begun to examine variations in the genomes of species across their present-day distributions as a way to investigate the extent to which ice-age climate cycles influenced past distribution and abundance. Most of this research has focused on species in the northern hemisphere; only a handful of studies have examined the effects on Africa's birds, and no study has yet been conducted in southern Africa.

To redress this, Fitztitute PhD student Ângela Ribeiro embarked on a project in 2007 to examine the evolutionary trajectories of four southern African birds: two arid-zone endemics, the Karoo Scrub-Robin *Cercotrichas coryphoeus* and Kalahari Scrub-Robin *C. paena*, the endemic forest-dwelling Brown Scrub-Robin *C. signata*, and the Cape Robin-Chat *Cossypha caffra* that occupies both arid and forest-edge habitats across southern Africa.

To obtain DNA samples, Ângela has travelled widely across South Africa and southern Namibia with her supervisor, Dr Penn Lloyd, and research colleagues to catch birds from which to take a drop of blood, before ringing, measuring, photographing and releasing them. Their effort has also received a substantial boost from several enthusiastic bird-ringers, who regularly send in samples from birds they have caught in their mistnets.

More than 800 samples have been collected to date, and Ângela is now hard at work extracting and sequencing DNA in the laboratory of co-supervisor Dr Rauri Bowie at the University of California, Berkeley. Once this process is complete, she plans to mesh the genetic data with extensive past and present-day environmental information to open a window on the way in which historic climate changes influenced the ebb and flow in the distributions of the four robin species. □

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