C and D Frith

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Songs of isolation?

In the cool rainforests of Queensland's tropical north, an evolution in communication is under way. The songs of birds, restricted to these 'upland' forests for millennia, have provided the first evidence that the geographic isolation of bird populations can promote song variation within species. The discovery, by David Westcott and his colleagues from the CSIRO Tropical Forest Research Centre and the CRC for Tropical Rainforest Ecology, has its origins in climatic history.

About 7500 years ago, cool rainforest covered much of the wet tropics region. But a period of warming, between 2000 and 5000 years ago, saw these cool rainforests contract to upland areas, about 600 metres above sea level, while warmer forest types dominated lower areas. As the cool rainforests contracted, so did the habitat of many species of birds, including the golden bowerbird, the fernwren and the mountain thornbill. This contraction fragmented the birds' habitat and saw populations of these endemic species split and become isolated: a process biogeographers call 'vicariance'.

Today, 13 bird species are endemic to the upland rainforests of the wet tropics, and exist in isolated populations between Cook Town and Townsville. What Westcott and his colleagues wanted to know, was whether this isolation (vicariance) had affected the birds, and, if so, how.

Birdsong is thought to evolve through a number of selective forces, such as natural selection (environmental pressure), sexual or social selection, and drift (vagaries of the learning process). So Westcott suspected that vicariance could play a role in promoting song variation among birds of the same species.

To test this theory, he recorded the songs of seven upland bird species and seven species of 'altitudinal generalists' – birds distributed across the upland and lowland regions – in seven rainforest blocks between Cook Town and Townsville.

He then analysed the 578 recorded songs using computer software that allowed him to measure a range of variables in song structure. The amount of structural difference was then analysed to see if upland species could be grouped into geographical locations more often than altitudinal generalists could.

'We were able to group all the upland birds into their different locations, based on their song variation, but only one of the altitudinal generalists,' Westcott says.

'So vicariance does play a role in promoting song variation.'

The scientists then asked what song variation between forest blocks actually meant. To answer this question, they played the recordings of golden bowerbirds from one forest block, to bowerbirds in another.

'The songs of upland bowerbirds vary uniquely from place to place and are as culturally distinct from one another as regional dialects or languages are to humans,' Westcott says.

'When we played a male bowerbird the local song he became aggressive because he thought another male was intruding near his bower. But when we played songs from the other forest areas, the male either ignored it or paused before showing a lowered aggressive response.'

Birdsong is a sexually selected trait that is used to identify others of the same species and to signal for a mate. These results therefore suggest that individuals that sing the wrong song will either not be recognised as a potential mate, or will be considered a low-quality one. 'These song differences may act as barriers to mating between golden bowerbirds,' Westcott says.

This raises the question of whether the upland bowerbirds are evolving into different species. If populations remained isolated for long enough this might occur, however Westcott says it is highly likely that populations will come into contact again before speciation is completed.

'If that happens sooner rather than later, the populations will again merge,' he says.

But the current study provides evidence that song differences can be caused by geographic isolation.

'It's a step towards understanding how signalling systems, such as bird songs, diverge and evolve' Westcott says.

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