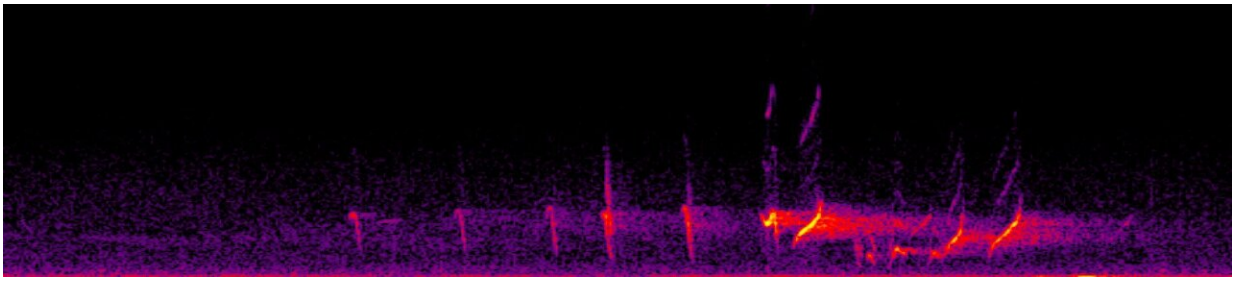
Evolution tunes birds to fit the bill

December 20 2019, by Anna Aaronson



A spectrogram showing the song of the White-plumed Honeyeater. Credit: Okinawa Institute of Science and Technology

From toucans to hummingbirds, the varying shapes and sizes of bird beaks show evolution in action.

Beaks are versatile, allowing birds to eat, regulate their temperature, and sing; these survival functions help determine beak length and size. Despite the complexity of beaks, most evolutionary studies have exclusively focused on a single function, like thermoregulation, rather than how a confluence of several functions impacts beak shape.

Using behavioral observations, morphological measurements, and mathematical analyses, researchers in the Biodiversity and Biocomplexity Unit at the Okinawa Institute of Science and Technology Graduate University (OIST), in a collaborative project with a lab in the Czech Republic, have found that beak shape is a compromise between

its many functions—a valuable insight into the nuanced processes driving evolution.

In addition, beak morphology impacts the songs the birds produce, which influences these animals' mating and communication practices. The scientists' findings, published in *Proceedings of the Royal Society B*, may also shed light on how birds are evolving in the present day in response to increasing urbanization and climate change.

Adapting to the environment

"There's something widely known in biology called Allen's rule; you tend to find animals with longer extremities in hotter regions and animals with shorter extremities in colder regions," said Dr. Nicholas Friedman, a postdoctoral researcher in the Biodiversity and Biocomplexity Unit. "Birds with really big beaks tend to live in the tropics, and those with little beaks tend to live in cold regions."

To see Allen's Rule in action, the researchers measured the average winter minimum temperatures and summer maximum temperatures endured by different species of Australian honeyeater bird. The scientists studied honeyeaters due to their morphological and geographic variety and abundance across Australia.

The scientists also studied beak evolution in relation to foraging behavior. Friedman and his colleagues used about 10,000 field observations of foraging activity in 74 species of Australian honeyeaters spread across Australia compiled by co-author Eliot Miller.

Friedman also took photographs of 525 bird specimens from a natural history museum in London. At OIST, he digitized the images to study beak morphology in detail.

Additionally, the scientists listened to hundreds of bird songs and measured their frequencies and speeds.

After obtaining this data, the researchers mapped different functions to beak curvature and depth, including nectar eaten, and the summer and winter temperatures they survived.

Shaping a better understanding of evolution

Upon further analysis, the scientists found that foraging ecology had a greater effect on the shape of the beak (curved versus straight), while climate had just as much of an effect on beak size. The shape and size of a beak also influences the song that is produced—a larger beak means a slower, deeper song.

"This paper therefore connects three things: thermoregulation/Allen's Rule, foraging behavior and song behavior together through the beak. We can then better understand how this influences mating and communication behavior," said Friedman.

Friedman's findings also have valuable implications for the future. Humans have had a great impact on the environment over recent years, and Friedman is interested to study how animals will evolve in response to climate change and urbanization.

"We've already seen birds change their song in response to noise pollution, and we've seen changes in beak size and body size due to climate," said Friedman. "These birds are evolving in real time in response to climate change."

More information: Nicholas R. Friedman et al. Evolution of a multifunctional trait: shared effects of foraging ecology and thermoregulation on beak morphology, with consequences for song

evolution, *Proceedings of the Royal Society B: Biological Sciences* (2019). DOI: 10.1098/rspb.2019.2474

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