COLD *comfort*

Winter strategies in birds

Non-migratory birds can face significant challenges in winter. Even in subtropical regions, winters may involve prolonged periods of low temperatures, often combined with reduced food availability. Birds' primary defence against cold weather is their ability to generate heat, even when inactive, by speeding up the rate at which fats and carbohydrates are metabolised. The metabolic 'engine' driving this increased heat production consists of muscles, including those responsible for flight, and internal organs such as the liver and kidneys. A key feature of this metabolic engine is that it is highly adaptable, with its performance modified in response to seasonally changing demands.

Fork-tailed Drongo

CHRIS VAN ROOYEN

Most of what we know about the physiological mechanisms that allow birds to survive cold winters comes from research conducted at far northern latitudes, where temperatures can be extreme. The major finding to emerge from these studies is that, with the onset of winter, birds adjust their metabolic machinery in a manner analogous to tuning a car's engine for higher power output. In these birds, both basal metabolic rate (equivalent to idling speed) and summit metabolic rate (equivalent to red-line power output) are significantly higher in winter than in summer. By seasonally adjusting their physiology in this way, birds that spend the winter in temperate and boreal habitats increase their capacity for sustained heat production.

In contrast, almost nothing is known about metabolic adjustments in species inhabiting regions closer to the equator, such as southern Africa. To begin addressing this lack of knowledge, Ben Smit and I recently investigated seasonal changes in the physiology of birds that are year-round residents in the Kalahari Desert. At our study site in Molopo Nature Reserve, we set up a field laboratory in which we could measure metabolism by monitoring the rates at which birds consumed oxygen and produced carbon dioxide when held in captivity for a few hours.

During the course of two field trips, one in winter and the other in summer, we measured the basal metabolic rates of five species, namely African Scops-Owl *Otus senegalensis*, Pearl-spotted Owlet *Glaucidium perlatum*, Fork-tailed Drongo *Dicrurus adsimilis*, Crimson-breasted Shrike *Laniarius atrococcineus* and White-browed Sparrow-Weaver *Plocepasser mahali*.

We initially expected that these species, like their northern hemisphere counterparts, would increase their basal metabolic rates during winter; after all, Kalahari winter nights can be bitterly cold. Surprisingly, our data revealed precisely the opposite pattern. All five species had significantly *lower* basal metabolic rates during winter compared to summer, with the most substantial reductions (approximately 35 per cent) in Fork-tailed Drongos. Rather than increasing their capacity for heat production during winter, these birds appear instead to be tuning their metabolic engines for enhanced fuel economy.

So why would Kalahari birds downgrade their metabolic machinery in winter, despite this being the coldest time of year? Lower metabolic rates translate into more frugal energy requirements and we think that food availability, rather than temperature, may be the major factor driving these adjustments. The number of terrestrial invertebrates at our study site was some 85 per cent lower during winter, representing a considerable reduction in food availability. On the other hand, night-time temperatures, albeit decidedly frigid, were not nearly as harsh as those experienced at higher latitudes in the northern hemisphere, and alternated with warmer conditions during the day.

We suspect that the combination of reduced food availability and comparatively mild temperatures has driven the evolution of enhanced fuel economy in these birds during winter. This thrifty approach may simply not be an option for species that winter in the far northern regions. Although those species also experience lower food availability, the significantly colder temperatures probably make an increased capacity for heat production critical for winter survival.

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